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GUY'S HOSPITAL

REPORTS.

VOL. III.

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LIST OF PLATES IN VOL. III.

Errata.— Pp. 163, 166, *for* " Dr. Cammins," *read* " Dr. Cumming."

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INTRODUCTION

TO

THE THIRD VOLUME.

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When we entered upon the commencement of the present work, we stated, that our leading motive was a desire to render generally available a number of important facts and observations, which would otherwise be lost to the majority of the profession; and we endeavoured to shew, that in a science like medicine, which requires an accumulation of facts, every man's available knowledge must be in direct proportion to the experience of which he is in possession; and we then proceeded to point out, that this experience is twofold—that which is derived from his own personal observation, and that which he receives from the testimony of others: whence we inferred, that as each man's individual observation must be restricted within certain impassable limits, the only means of rendering medical knowledge permanently and steadily progressive, must be to bring continual additions to the general stock of accessible observations; or, in other words, to place within the reach of medical readers, collections of authentic records.

Having thus stated our motives in commencing our present course, we may perhaps be allowed, now that we are somewhat advanced in our career, to look back upon the ground we have trodden, and forward to that over which we have yet to pass, to see what inducements may thence be drawn for continued

exertion. These inducements are from within and from without—from the benefits which we feel to be accruing to ourselves, and the reception which we have met with from the public; as well as our own convictions as to the class of medical works of which the public are most in need.

Now, as regards those who are more immediately engaged in the conduct of the work, we need hardly remark, that in so vast an institution as that from which it proceeds, opportunities of experience, to an almost unparalleled extent, must be continually presenting themselves; and that next to these opportunities, nothing is of more value than an inducement to turn them to the fullest account, and the habit of doing so. Both these are, we think, supplied by the feeling of being called upon to support a work which professes to be, for the most part, a record of experience;—and in this place we cannot help reverting to the fact, that no inconsiderable portion of the materials of this publication are furnished by the Hospital Pupils, and to the consequent diffusion amongst them of a zeal for clinical observation. But of this we have before spoken*.

Again: in looking around us, upon the profession at large, we cannot but hope that we are rendering no trifling service to a large portion of its members—we mean those who have not long ceased to be pupils, and are now entering, or not far advanced, upon their professional career. And here regard must be had to the altered state of medical education within the last fifteen or twenty years—a knowledge being enjoined of many sciences, with which the majority of our predecessors were unacquainted. This is to be attributed, in a great measure, to the convergence of many branches of know-

* See account of the Clinical Report Society, Vol. II. p. 5.—We take this opportunity of stating, that this Society, which is, we believe, unique, continues in a most efficient condition, and has equalled, or even exceeded, the anticipations which were formed at its first establishment.

ledge upon medicine, whose relation to it was heretofore overlooked: and although we are far from regretting this extension of the acquirements of the medical practitioner, we cannot disregard the evils to which it may, in some cases, give birth: for it should be remembered, that although many of these, which are termed the collateral sciences, are converging upon medicine, they have not yet been actually brought to a focus upon it. They are indeed the handmaids to medicine, and minister much valuable assistance; but their province is distinct from, and subordinate to, that of their mistress, and should ever remain so.

Let us take for examples, botany and chemistry: these have undoubtedly conferred important benefits upon medicine: by both have many valuable additions been made to our materia medica; and the latter has, moreover, furnished us with many aids to diagnosis, by enabling us to recognise important changes in the fluids and secretions of the body, which we could never have detected by our senses. We are then far from undervaluing these departments of knowledge, or endeavouring to throw impediments in the way of their prosecution: on the contrary, we exult, as we believe we justly may, in the numerous band of accomplished men (many of them members of our own body), who are so ably and zealously devoting themselves to their advancement: but we ask, Is it well that they should engross so large a proportion of the time spent by the majority of the profession, in preparing themselves for the exercise of their calling? It is well to be acquainted with the chemical changes that occur in the preparation of proto-chloride of mercury; but will this knowledge suggest the uses of ca-lomel?—If a plain fact is to be stated in plain terms, it is, that neither anatomy nor physiology, and still less botany or chemistry, is medicine. This, it may be asserted, is a truism,

and one which has little reference to our present subject.
We admit that it is a truism; but we think it, notwithstand-
ing, of no inconsiderable import.   When the time allotted to
professional studies is considered—although that period has
lately been most wisely extended—and when the range of
those studies is also taken into the account—does there appear
to be no danger, that, in some instances at least, that which
is subordinate may in a great measure supersede that which
is essential.

We are not arguing against the utility of these sciences: on
the contrary, we admit that an acquaintance with them is
not only desirable, but indispensable.   But we ask, Is time
always given for the study of the practical application of these
acquirements to the treatment of disease?   Now, it should not
be forgotten, that the preparation of the mind for the exercise
of our art, as for every other arduous course of action, may
be divided into two parts; first, that which is initial, and
consists in the expansion—we might even say, the scattering—
of the faculties over as wide a field as possible, by which new
ideas are collected from a thousand different sources; and,
secondly, that maturing process which is in some measure
the reverse of the first: it is the process of condensation and
concentration: it is the bringing of all materials and all
faculties to a point, upon that one principal matter which has
been already chosen as the worthy object of a man's most
energetic pursuit.   But, can it be said, that, under the present
system of things, professional education is never interrupted
at the juncture of the initial and the conclusive part, or, at all
events, before the latter is completed?   And will there not
thence ensue a want of all fixed principles of action?—will
not those very acquirements, which a further progress would
have rendered available to the main object of treating disease,
be felt to be little better than incumbrances, and, perhaps, be

altogether thrown aside? And what are the resources under such circumstances? Some screen themselves under a scrupulous avoidance of all rational or decisive practice; and some run to a reckless and daring empiricism:—we trust that the former is the more prevalent error.

But it may be said, that time enough will be given, after a man enters upon the exercise of his profession; and that he must then practically learn the use of those attainments of which his previous course of study has put him in possession. We are deeply impressed with the conviction, that a medical man should be all his life a learner; but we think that the commencement of practice, with all its attendant anxieties, is no fit time for a first essay at drawing practical inferences in matters of such vast importance.

We have stated these apprehensions, not with any design of calling in question the propriety of arrangements which have lately been made; but because, since every state of things must have its peculiar dangers, and every condition must bring with it its peculiar wants, we feel that we are not only at liberty, but even called upon, to inquire what are the evils most to be apprehended in the present condition of the profession; and what are the means which, as far as the press is concerned, appear most fitted to avert them.

Now, if it should be found that a young man not unfrequently loses the opportunity of attending the wards of an hospital, just at the very time when such attendance could be turned to the greatest account, what is the best remedy for the loss, that medical literature can supply?—obviously, as we think, digested records of cases and observations occurring in medical and surgical practice, accompanied by clinical remarks and deductions. We are convinced that they must be so arranged, and so accompanied, to be of real utility; and it is upon this conviction that we have been more anxious

to present to our readers, monographs, illustrated by cases, than the crude records of the cases themselves: and it is upon the same principle, too, that we have not scrupled to introduce cases occurring in private practice, where they have tended to elucidate the subject before us: and we think, that, in so doing, we are adopting the only plan by which we could hope to render efficient service to those to whom we are at this moment more particularly addressing ourselves— we mean, the younger members of the profession, who are anxious to continue their clinical studies beyond the term of their pupilage.

If individual cases were all that were required, they might be found within the range of each man's own observation; and enough are supplied in the periodical literature of the day. But these single instances are, for the most part, ill adapted to remove the difficulties in which complicated questions are involved. Every man in his private sphere has to do, not so much with the average result of general rules, as with the special issues of single throws: the cases that he encounters, as trials of his skill, appear like fortuitous combinations, rather than instances which might illustrate any given law. He meets with at least as many exceptions, or seeming exceptions, as cases in point: and thus the young practitioner is often not a little at loss how to apply to the case before him the rules of treatment which he may have obtained in the lecture-room, or from the works of systematic authors. He may, indeed, if he so choose, compel each case into a station in a system of nosology; but woe to his patient, if his remedies are selected accordingly!

We are aware that the first lessons in the practice of medicine must be systematic, in order that they may be understood or remembered. But in such, it is often difficult, or even impossible, to connect precept and example. Indeed

we believe that their separation is one amongst the evils of that unfinished, or rather interrupted, medical education, to which we have alluded. To remedy this evil, clinical lectures have been instituted; and we cannot accuse the pupils of the London Schools of being indifferent to their importance. But this mode of instruction, to be most efficient, should occupy the concluding portion of the period of medical study— a time during which, it should be remembered, that a large proportion of medical students are engaged in preparing for examinations embracing a variety of subjects.

It should also be remembered, that the greater number are deprived of the opportunity of attendance upon hospital practice, almost immediately after they have passed their examinations;—an advantage of which (if we may judge from regrets which we not unfrequently hear expressed) many would gladly avail themselves.

To such, then, we trust that our pages will prove more especially serviceable: though we, at the time, indulge the hope that they will not be found altogether unacceptable to the profession at large. Should we, indeed, continue our efforts beyond the term which has been assigned to us by the predictions of some of our friends, we may, perhaps, take occasion hereafter to say a few words relative to other ends which we hope to promote: but in the mean time, we would beg to assure our readers, that we are as yet insensible of any diminution in our resources; and that we indulge the hope, that increased experience in the work we have undertaken may increase our powers of usefulness in its performance.

ON

SPERMATOCELE,

OR

VARICOCELE OF THE SPERMATIC CORD.

BY SIR ASTLEY COOPER, BART. F.R.S. D.C.L.

SERJEANT-SURGEON TO THE QUEEN,

AND CONSULTING SURGEON OF GUY'S HOSPITAL.

By the above-mentioned terms, I mean to express an enlargement and alteration of structure in the spermatic veins. It is of frequent occurrence, but is sometimes only a slight inconvenience : in other instances, it produces a great deal of local suffering and of mental depression.

Although the veins are generally larger than the arteries in the various structures of the body, yet it appears that the disproportion between them is greater in the spermatic cord and testis than in other organs.

In the erect position of the body, they become extremely distended with blood: but in the recumbent posture, are comparatively empty; so that they undergo great changes in their bulk from alterations in position, being influenced by the following circumstances :—

1. The height of the column of blood leads to their great distention ; for although they possess numerous valves, yet the free lateral communication which exists between them, by anastomosing branches, allows the blood to retrograde to the testis through these communicating channels, and to gravitate with force upon the vessels.

2. Under an increase in their diameters, the edges of the valves no longer meet, and the blood descends between them ; so that they only partially perform their natural office so long as the enlargement of the veins continues.

3. Relaxation, produced by age or by a warm climate, not only has the effect of relaxing the scrotum, but the veins of

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the spermatic cord also lose their support from the surrounding parts; and thus is this complaint produced and continued.

4. Clothes worn tight around the abdomen have the effect, by their pressure, of preventing the free return of blood into the inferior cava, from the spermatic veins.

The belt also, with which it has been so much the custom to encircle the abdomen, has a strong tendency to produce this effect, as well as, by its pressure upon the abdominal viscera, to force them from their proper cavity; and thus to produce a spermatocele on the one hand, and a hernia on the other; although the belt is sometimes absurdly recommended to prevent both these effects.

5. Corpulency has a similar tendency to produce spermatocele; for the accumulation of adeps in the omentum and mesentery adds to the pressure upon the returning veins, and leads to the excessive distention of those vessels.

Spermatocele—as every surgeon knows, who is the least familiar with this disease—occurs more frequently in the left than in the right spermatic cord; yet I have several times seen it on the right side; and have a good preparation of it.

The reasons which may be assigned for its greater frequency on the left side, are,

1st, The left testis hangs, in general, lower than the right; and, consequently, the column of blood returning from it is higher than that of the right, and the blood gravitates more powerfully in the erect position of the body.

2dly, The left spermatic vein terminates in the left renal vein, at nearly a right angle to the course of the blood in the two vessels; by which the stream of blood in the spermatic vein is somewhat interrupted, or the freedom of the flow diminished: and the constant operation of this cause produces distention and enlargement of the spermatic vein.

3dly, The renal vein terminates at nearly a right angle with the stream of blood in the inferior cava; and thus a second impediment to the return of the blood is produced from the left testis, whilst the spermatic vein on the right side forms no angles in its course to the vena cava inferior.

4thly, The left renal vein is much exposed to the pressure of the viscera as it crosses the fore-part of the aorta.

That these circumstances do operate to produce sperma-

tocele is proved by its occurrence in the female, in whom it also happens on the left side; and the ovaria being upon the same level, or nearly so, there does not exist a higher column on the left side to produce the effect: yet I have never seen this disease in the female but on the left side; although I do not mean to deny altogether the possibility of its occurring on the right.

Spermatocele produces a pyriform swelling of the spermatic cord; unless it be very pendulous, when it forms a double cone with the testis near the middle: and it may be traced in the inguinal canal, to the upper ring, and even into the abdomen, in relaxed abdominal rings.

The sensation which it gives to the fingers, on manipulation, is, that tortuous cords, or small twisted ropes, are contained in the swelling; and the fingers sink between these cords, and meet between them at the back of the scrotum.

In some persons, whose skin is thin and delicate, the complaint assumes a bluish appearance; for the colour of the blood appears through the scrotum.

In all persons, it diminishes in the recumbent, and increases in the erect position; and it is lessened by cold, and increased by heat.

In those cases in which the swelling extends into the inguinal canal, it becomes influenced by the action of the abdominal muscles; and coughing or straining produces a sudden increase of the swelling, so as to give it, in that act, a resemblance to hernia, by forcing the blood backwards into the veins.

The testis, in spermatocele, is generally soft and relaxed; and it is somewhat smaller than the other. It also does not fall, as it naturally does, to the bottom of the scrotum, but is suspended about midway between the external ring and the bottom of the scrotum. It hangs anteriorly to the spermatic cord, with what appears like a bundle of twisted and knotted ropes above and below it, reaching to the bottom of the scrotum.

In some persons it is discovered accidentally; but in others, a sense of weight, and feeling of uneasiness in the course of the spermatic cord, lead to a knowledge of its existence by inducing a careful examination of the part.

It sometimes produces a sense of depression in the stomach,

and disturbs the digestive process, and thus becomes a great source of annoyance; also, much pain, weight, and uneasiness are produced in the loins.

In some persons, the disease occasions a mental depression. The patient believes himself bereft of his virile power; and this impression, with the pain he feels in the part and in the loins, with the weakened powers of digestion, and the influence this produces on the nervous system, leads him to seek assistance which he has not been able to obtain; and he is ready to accede to any proposal for his relief.

In general, however, this complaint produces little inconvenience, and is scarcely heeded by the patient, in the greater proportion of cases: and it ought not to depress his spirits, nor is there cause for apprehension, either for the present or for the future.

When spermatocele is dissected, the spermatic veins are found dilated and elongated, and more tortuous than they naturally are: their coats are exceedingly thickened, and they appear to be much more numerous than before the formation of the disease; although this appearance arises only from the increase of the smaller vessels, and not from the production of additional vessels. From the thickening of their coats, the veins appear as arteries, when they are cut across; for they remain patulous.

If quicksilver be poured into the vein, at its termination in the renal, it at once descends to the testis, with scarcely any interruption; and the veins can be injected with wax, in a direction contrary to the course of their blood.

From the increase of their diameters, and the valves no longer meeting at their edges, the whole of the blood in the spermatic vein forms a very high perpendicular column, and has a constant tendency to increase the disease.

From their elongation, they become unnaturally tortuous; for they grow in length as well as in diameter.

As this complaint in many respects resembles hernia, and has often led to the improper application of a spring truss, it is necessary to point out the distinction between the two diseases: for the application of a truss not only produces no advantage, but it is, on the contrary, productive of great injury; and increases the complaint, by preventing the

return of blood through the veins. However, the mistakes to which I have alluded are very liable to happen, from some of the symptoms being similar in the two diseases.

Like hernia, this complaint begins in the course of the spermatic cord, or at least appears in that course. Like hernia, it increases in the erect, and subsides in the recumbent posture. Like hernia, when it occupies the inguinal canal, it dilates in coughing. Like hernia, it increases by pressure on the abdomen; and, like hernia, it fills from the abdomen, when it has been emptied.

But it is unlike hernia, from the irregularity of its surface, and from the feel of tortuous and knotted cords in the swelling: it is unlike intestinal hernia, in the absence of the gurgling noise which attends the return of the intestine into the cavity of the abdomen; and it is unlike the same hernia, in its not inducing an interruption to the passage of the bowels.

But the best discriminating marks are the following:—The patient is desired to place himself in the recumbent posture: then the surgeon presses upon the spermatic cord, and raises the testis and swelling, and it disappears: he then places his fingers at the external abdominal ring, and directs the patient to rise; and if the swelling be varicose, it immediately re-appears; but if it have been hernia, it cannot re-appear. Even pressure at the abdominal ring, without the patient returning to the erect position, will reproduce the swelling of the spermatic veins, by preventing the free return of the blood; but the pressure must not be sufficient to arrest the blood in the spermatic artery, or the veins will remain empty.

Spermatocele might be confounded with congenital hydrocele; as it also fills in the erect, and disappears in the recumbent posture: but the transparency of this hydrocele will lead to a sufficient diagnosis.

OF THE TREATMENT OF SPERMATOCELE.

The applications for a remedy in this complaint are numerous and frequent; and would be abundantly more so, but for the general conviction of the hopelessness of relief.

In general, it is only an inconvenience to the patient; and

the plan of treatment consists in supporting the part: and this is effected by applying a suspensory sling, with two tapes sufficiently long to encircle the abdomen. The sling receives the scrotum and testis; and the tapes, passed around the abdomen, and tied in front, secure the parts in an elevated position. No straps should be placed beneath, to pass between the thighs; as they draw back, rather than elevate, the scrotum and swelling.

As the parts should be kept as cool as possible, the material of the sling should be an open *silk net*, which allows the escape of heat, and prevents a relaxing perspiration. From this support the patient derives great relief; and the application of an evaporating lotion of spirits-of-wine and water relieves him still more. A very good lotion for this purpose consists of aluminis ʒi. aquæ ʒxi. spiritus vini ʒi.; but the lotion should be as much as possible devoid of smell, as it leads to the suspicion of some infirmity.

Washing two or three times a day with cold water, with salt dissolved in it, is useful; and the employment of the shower-bath, or common cold-bath, by constringing the scrotum, prevents the increase of the complaint.

The dress should be as light as possible, to prevent the production of superfluous heat, and to permit its escape; and all tight dress around the abdomen is to be avoided, to allow of the free return of the venous blood from the testis. Still, however, these means leave the patient with the badge of his infirmity, from his continuing to wear his bandage; and attempts have been made to relieve him, by exciting inflammation and thickening of the scrotum, and thus to render it a better support to the testes. I have applied the pyroligneous acid for this purpose; but the pain which it excited was severe, and the good effect only temporary. I have also employed blisters with the same view, and with the same effect.

It has been advised to draw the scrotum through a ring, and fix it there, the person continuing to wear it; but, as it may be readily believed, this has no advantage over the use of the sling-support; and is a much greater annoyance to the patient's feelings, either than the disease itself, or the bandage which he is usually called upon to wear.

Yet there are cases in which this complaint produces so much pain of body and mental distress, as to render it absolutely necessary to do something more than is generally advised. The patient has constant pain, and a feeling of weight in the scrotum, which leads him to support it with his hand, and frequently to change the position of the parts. He suffers much in exercise, both in riding and walking; and he has pain in the course of the spermatic cord, and in the loins on that side. He has a sinking sensation at his stomach; his mind is never free from anxiety and depression, from a belief that his powers are diminished; and his life is rendered miserable. The complaint is no longer a simple inconvenience, but is a source of constant annoyance; and he most eagerly seeks some mode of relief. In such severe cases, the patient is sometimes anxious for the removal of the testis; as he does not regard the pain of an operation, when contrasted with the constant uneasiness which he suffers. Of this I will give the following case, from an operation on a patient in Guy's Hospital, performed by Mr. Key.

" T. H., aged 18 years, was admitted into Guy's Hospital,
" under my care, in June 1826, for an enlargement of the
" veins of the spermatic cord, accompanied with considerable
" pain.

" About three years ago, whilst he was in the act of
" mounting a horse, the animal sprang forward; and on his
" descent upon the saddle, his left testicle was much bruised,
" and produced, for a few minutes, excruciating pain. In a
" fortnight, the effects of the accident had nearly subsided;
" but from this time he remarked that the testicle felt softer
" than the other, and occasionally gave him pain along the
" cord; and he also imagined that the gland gradually
" wasted. Till within the last six months, it did not give
" him much inconvenience; but latterly it has begun to swell,
" and has become more painful when he has been engaged in
" any active employment. The part now presents an irregular
" knotty swelling at the superior and back part of the testis,
" extending some way up the cord; and it conveys to the
" hand the impression of a bundle of cords, with knots tied
" in them. The testicle is soft, and not so large as the other;

" and gives pain when handled. The pain is chiefly referred
" to the loins.

    " The swelling in the veins has the usual characters of
" hernia; dilating upon coughing, and increasing in the erect
" position of the body.

    " At his earnest request, the operation of removing the
" testicle was performed, after the ineffectual application of
" sedative local remedies, leeches, and a continued horizontal
" posture, with alterative medicines. It was at one time sug-
" gested that a ligature on the spermatic vein might succeed
" in curing the varicocele; but the natural irritability of the
" patient's constitution forbade such an operation*.

<div align="right">" CHARLES ASTON KEY."</div>

Although the foregoing is a most severe case, and of rare
occurrence in so aggravated a degree, yet I have seen, in
the course of my practice, many persons suffer so severely
in body and in mind from this complaint, that they would
readily submit to any operation which was not attended with
danger to life, to obtain relief. As to tying the veins of the
spermatic cord—from what I have seen of the dangerous and
destructive effect of exciting inflammation in veins—I should
never propose it; nor do I think, if it were not dangerous,
that it is founded on proper principles. But, in my Work on
the Testis, published in the year 1830, I have advised the
removal of a portion of the scrotum, in the following words :—

    " *The removal of a portion of the scrotum will lead to a dimi-*
" *nution of the veins of the spermatic cord; and it is an opera-*
" *tion, in an extreme enlargement accompanied with pain, which*
" *might be tried with perfect safety, and is very likely to*
" *succeed.*"

I had, at that time, never performed the operation, and I
therefore spoke of the probability of success only: but, aware
of its being free from danger, and seeing that it would
render the remaining portion of the scrotum a natural

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* See Plate I.

bandage, and that a great degree of relaxation of the scrotum also attended this complaint, and that such relaxed portion might be safely and effectually removed, I determined to take some opportunity of performing the operation.

Beside the advantage of making the scrotum, in its lessened state, a means of support, it must naturally occur, that the adhesion, excited by the operation, of the fascia which covers the cremaster, to the surrounding parts would produce a permanent support, and render a suspensory bandage unnecessary. It might be thought a painful operation; but it is not so, nor does it excite constitutional irritation.

The mode of performing it is as follows:—The patient being placed in the recumbent posture, the relaxed scrotum is drawn between the fingers; the testis is to be raised to the external ring by an assistant; and then the portion of the scrotum is removed by the knife or knife-scissars;—but I prefer the former. Any artery of the scrotum which bleeds is to be tied; and a suture is then made, to bring the edges of the diminished scrotum together. The patient should be kept for a few hours in the recumbent posture, to prevent any tendency to bleeding; and then a suspensory bag is to be applied, to press the testis upwards, and to glue the scrotum to the surface.

The only difficulty, in the operation of removing the scrotum by excision, is in ascertaining the proper quantity to be removed; but it adds but little to the pain if a second portion be taken away, if the first does not make sufficient pressure on the spermatic cord. It is of no use to remove a small portion of the scrotum, for from doing this I have failed. When the wound has healed, the varicocele is lessened, but not always entirely removed; but the pain and distressing sensations cease, if sufficient of the scrotum be removed.

In making the suture in the scrotum, its lower part is to be brought up towards the abdominal ring, to raise and support the testis; as does the suspensory sling when it is worn.

CASES.

CASE 1.—Mr. Rees, surgeon, of Blackfriars Road, sent me a patient of his, who had a large varicocele on the left side, with a very relaxed scrotum. He suffered severely from uneasiness in the spermatic cord and in the loins, a sense of weight and oppression in the region of the stomach, and excessive mental depression. On the 18th of February 1831, I removed a large portion of the scrotum; and exposed the fascia covering the cremaster, and the testis in its envelopes. By three sutures, the edges of the scrotum were approximated, and the wound quickly healed; and he, on the 3d of March afterwards, quitted London. Through the kindness of Mr. Rees and Mr. Webster, I have received the following account of the result of the operation :—

" DEAR SIR—The gentleman on whom you operated was
" 32 years of age. The portion of the scrotum removed,
" when extended, measured four inches in length; and in
" breadth, in the middle, two inches and a half. He left
" London perfectly well, and I have sent you his address.

" I am your obedient servant,

" 240, *Blackfriars Road.*   " JOHN REES."

From Mr. Webster I have since learned the following particulars :—

" The gentleman is able to ride fifty miles a day, with-
" out inconvenience; although, before the operation, he could
" not continue on horseback more than two or three miles :
" and in a Letter which Mr. Rees has received from him, he
" expresses himself in the highest terms of gratitude for his
" recovery."

CASE 2.—Mr. S——, aged 20, has had a spermatocele three years and a half, attended with a great sense of uneasiness in the part, and a dull heavy pain in the spermatic cord and loin on that side. My assistant, Mr. Balderson, held the scrotum between his fingers; and I removed all that could be easily elevated from the testis and its coverings,

which are necessarily exposed in the operation. I then brought the integuments together by sutures, so as to close the wound completely; but I previously secured some small bleeding arteries. He was ordered to keep himself cool, and to remain in the recumbent posture; and the part was placed in a suspensory sling: however, the next morning he went down to breakfast; but this imprudence did not prevent his quick recovery from the operation, with the result of which he was highly pleased. The varicose veins are greatly reduced: the coverings of the testis adhere to the upper part of the scrotum. He soon gave up the use of the sling-support; and lost the pain in the spermatic cord and loins, which he had previously sustained.

CASE 3. — H. B., aged 18 years, had a spermatocele upon the left side, from the age of fourteen. At fifteen he fell across an iron bar, which greatly hurt him; and he thought the complaint had quickly increased after that time. He suffered much from pain in the testis, more especially in walking, and from uneasiness in the groin, spermatic cord, and the spinous process of the ilium and loins. He consulted several medical men, who told him his complaint was a hernia. But he was then recommended to Mr. Taunton, in Hatton Garden; who informed him it was a varicocele: and the scrotum was directed to be supported, and an evaporating lotion to be used.

On July 20, 1837, I removed a large portion of the relaxed scrotum which covered the swelling, in the presence of Mr. James Babington; secured some small arteries; and then used four sutures, to approximate the edges of the scrotum. He was sent from my house, in a coach, to Chelsea, after the operation; and the scrotum very soon healed, and the uneasy sensation in the part vanished.

CASE 4.—Mr. JOHN K——, aged 25, four months ago found the scrotum enlarged on the left side, with occasional pain in the part, which darted upwards to the external abdominal ring. It gradually increased, until it was three times larger than the right side of the scrotum, became more painful, and

occasioned much depression of spirits.   On the 15th of
October 1837, I removed a portion of the scrotum, by passing
a needle and thread through it in three different places, and
cutting away the scrotum beyond them.   This plan did not
facilitate the operation, and made the tying of the arteries
more difficult; but it succeeded in relieving the disease.

I am obliged to Mr. Key for sending me the following case.

" In the autumn of 1837, a young man, aged 18, suffer-
" ing much from a painful varicocele, applied to me, to know
" if I would advise him to submit to the operation of tying
" the veins, which had been recommended by a surgeon.
" The varicocele, which was on the left side, was large, and
" more than usually pendulous; the veins forming a large
" festoon, that could be distinctly felt through the scrotum.   I
" explained to him the risk and inefficiency of an operation
" on the veins, and also the simple operation which you had
" practised for the cure of varicocele.   The pain that he
" experienced in following his occupation induced him at
" once to have the operation performed.   With the assistance
" of my dresser, Mr. Whitchurch, I removed about two inches
" of skin, so as to shorten the scrotum from above to below.
" The edges of the wound were secured by pins; but an oozing
" of blood into the cellular membrane interfered with the
" process of adhesion, and the whole healed by granulation.
" The relief which he has thus obtained, since the wound
" closed, will induce me to have recourse in future to the
" operation, for a painful varicocele.   The support which the
" veins would have received if the wound had healed by
" adhesion would have been more effectual; and I should in
" another case take every precaution to ensure the adhesive
" process."

In one case, I raised the scrotum, and placed a ligature
around the part which I designed to remove, drawing the
thread quite tight: but it produced a great deal of pain;
the part sloughed with considerable constitutional irritation,
and after a great length of time, and with more suffering
than the complaint justifies.

I wish it to be recollected, that I only recommend the

removal of a portion of the scrotum in those cases of spermatocele in which the patient suffers great local pain; in cases in which he is most urgent to have the swelling and deformity of the part removed; and more especially in those instances in which the function of digestion suffers, and there is a great degree of nervousness and of mental depression. For slighter cases, a suspensory bandage must be still recommended.
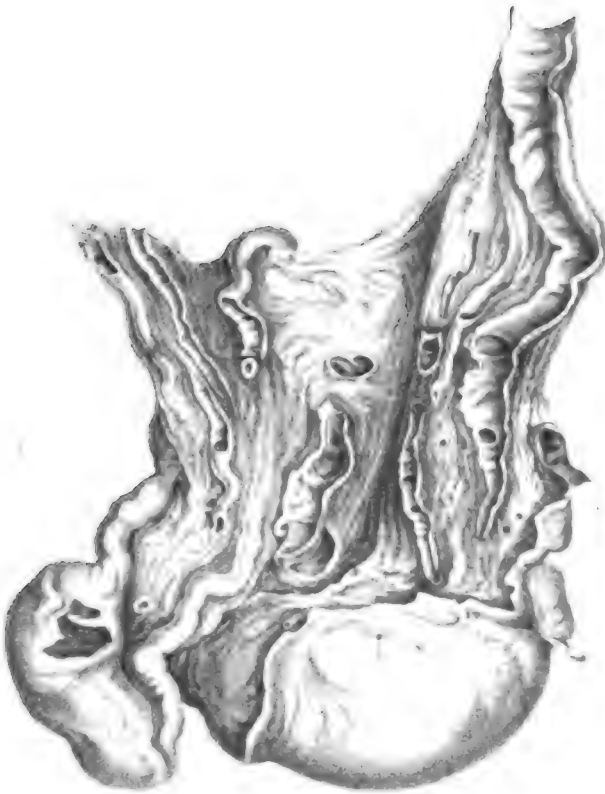
PLATE II.

A PREPARATION OF VARICOCELE, PRESENTED TO THE MUSEUM AT
GUY'S HOSPITAL BY SIR A. COOPER.

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This preparation shews the great relaxation and elongation of the veins, and their extension below the testis.

Plate II
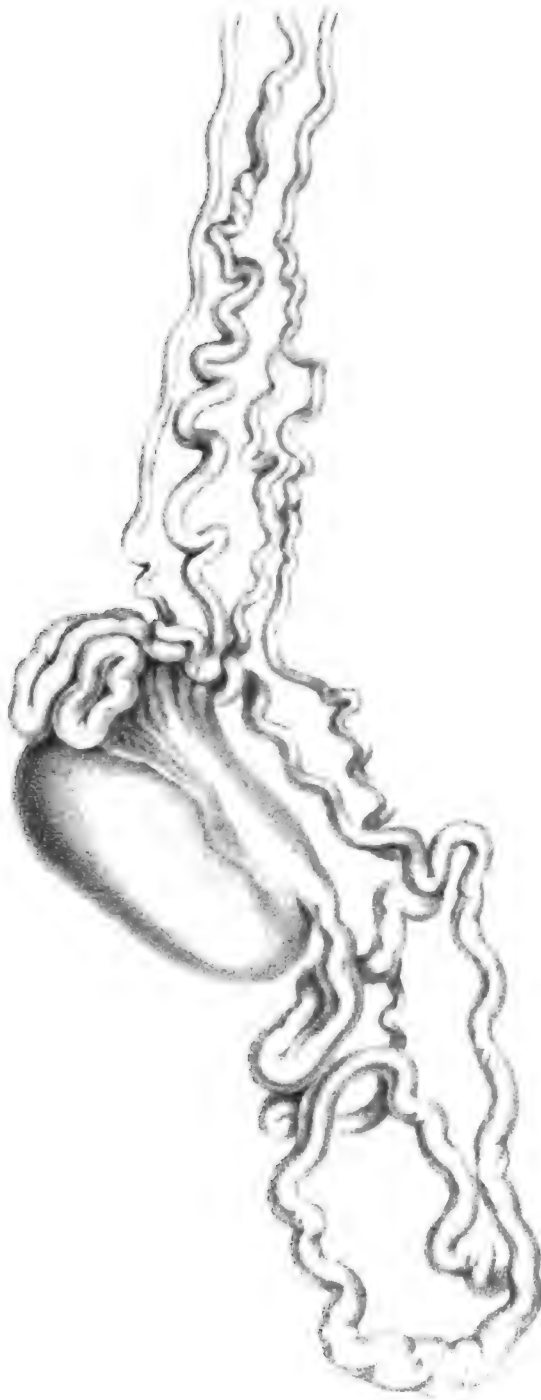
ON

PARAPLEGIA

DEPENDING ON

DISEASE OF THE LIGAMENTS OF THE SPINE.

BY C. ASTON KEY.

THE causes of Paraplegia are frequently so obscure during life, and, after a careful examination of the dead, so often elude our search, that any additional facts tending to throw light on this affection deserve to be placed on record. The diagnosis also of these cases, it is well known to all who have seen much of this form of paralysis, is difficult and dubious; and the treatment recommended is oftener founded on empirical, than on rational or scientific principles. The record of the following cases may serve to call forth further examination of these spinal affections; and, by eliciting additional facts, will assist in distinguishing between the several diseases of the spinal cord and brain that give rise to paraplegia.

Mr. Earle's and Mr. Stanley's Papers, in the Medico-Chirurgical Transactions—two very able expositions of the causes of paraplegia—do not include among them the peculiar spinal disorder that forms the subject of the following remarks. It was in the attempt to verify the correctness of the pathology of the latter surgeon, that I first observed the change in the ligaments of the spinal canal, which the following cases will explain.

CASE 1.

SAMUEL D———, aged 48, of strong frame and healthy appearance, was admitted into Stephen's Ward, Oct. 21, 1835, with a stricture of the urethra, and a fistula in the perinæum. He considered himself to be in good health; with the exception of a pain across the loins, arising, as he thought, from his stricture. About seven years ago, his stricture caused him much trouble, but he was relieved by the catheter and bougies.

At the time of his admission, the urine, which was sufficiently abundant, and healthy in appearance, passed in consi-

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derable quantity through the perinæal aperture; and the stricture was firm and very contracted, and allowed with difficulty the smallest sound to be passed. The passing of the instrument was attended with great pain in the perinæum. Under the use of the catheter, and the exhibition of camphor and hyoscyamus, he steadily continued to improve; and nearly the whole of the urine passed through the urethra. A day or two before the 10th of November, he complained of being unwell; and on the night of that day he became suddenly delirious, and was found labouring under fever; his extremities, at the same time, being exceedingly cold. These symptoms yielded to sinapisms, opium and ammonia, and counter-irritation to the back of the neck. Up to the 28th he improved; but was found to have nearly lost the power of motion in the right leg; for which he was cupped, and blistered on the loin. Fever returned, with affection of the sensorium, and a very diminished secretion of urine: he complained of severe pain across the upper region of the abdomen, extending into each loin, especially the left. In the second week of December the left leg became paralytic; and he continued incapable of moving either, though he imperfectly retained sensation in both. On the 25th, he was attacked with diarrhœa; which was checked by chalk mixture with opium, but returned at intervals. All his symptoms of constitutional disturbance and local uneasiness became aggravated, so that turning him in bed induced extreme suffering. He remained in this state till the 2d of January, when his powers began rapidly to fail; and he died on the following day.

The body was examined by Mr. King.

The viscera of the chest, and those of the abdomen, with the exception of the colon, were healthy. The colon was inflamed throughout its inner surface, a large part of which had been removed by ulceration. Over the right kidney was a peritoneal cell; which contained feculent matter, leading into the colon. The rectum, near the anus, presented several extensive and recent ulcers. Both kidneys were injected with blood, and coarse in texture; and in one were two or three minute points of suppuration: their structure was firm. The bladder was much thickened. In the substance of the psoas muscle a large abscess had formed, extending nearly to the origin

of the muscle, and downward to its insertion; and communicating with a collection of pus in the hip-joint, the ligamentum teres of which, and part of the articular cartilages, were destroyed by ulceration. The head of the femur, and the acetabulum, seemed to be expanded; and the neck of the former was surrounded with bony deposits of old formation. The vertebræ were free from ulceration. The bodies of the lumbar vertebræ were covered with irregular prominences of bones, and the intervertebral substances projected more than usual. Within the canal of the spine, the ligaments covering the intervertebral substance between the second and third lumbar vertebræ were found hardened and prominent; and projected so far into the canal, as to diminish it by one third of its diameter, thus causing considerable pressure on the spinal marrow.

Case 2.

Reported by Mr. Aspland.

George Weeks, aged 44, admitted July 6, 1836, into Job's Ward, under the care of Dr. Back. A man rather tall, and of a healthy appearance. He has been for some years employed in carrying out beer for a public-house: this has exposed him to long-continued and fatiguing exercise, but none of a violent nature. His health has, in general, been good; but twelve months ago, during the hot weather, and after increased exercise, he experienced a feeling of weakness in the left knee, which soon extended to the foot, accompanied with numbness and a sensation of cold. The right leg became similarly affected in a week or two; and he suffered from catching-pains in the hip-joint, upon motion. He however continued his work, his legs being sometimes worse sometimes better, till last Saturday; when, from increased weakness in the legs, he was obliged to leave off. Two months ago he first noticed a want of power in the sphincter ani; which had increased so much in a month, that he could with difficulty retain his motions: from the same period, giddiness has supervened, upon any exertion.

State on admission.—Almost entire loss of power in the lower extremities, more particularly the left, with numbness, tingling, and occasional pain extending from the loins downwards; inability to empty his bladder, except in drops;

c 2

numbness in the extremities, and imperfect command over the
rectum, his motion frequently passing involuntarily : no pain
in the back, either upon pressure or motion; no pain in the
head, but occasional giddiness; no weakness in the arms;
appetite good; sexual passion extinct.

    To have low diet. Catheter passed night and morning.
    MM. c̄ MS. Cal. gr. ij. o. n. CC. lumbis ad ℥x.

July 7. No alteration, except an increase of general weakness.

   8. Feels better; more power and less torpidity of the legs.   •

  13. In the same state.   CC. lumbis.

  16. Suffering still from catarrh and general uneasiness. Feels
considerable pain in the hypogastric region. There is a constant
quivering of the under-lip. His intellects are rather dull; he is
rather backward in answering questions. Mouth slightly affected.
A sore on the back, where the scarifications were made.

  25. If any change, it is for the better. The pain in the bladder
still remains; and he often experiences a sensation as if the bladder
were filled with warm water : does not micturate frequently. The
urine is of a dark colour, and of very ammoniacal odour. His mo-
tions are natural, but passed in bed.

  26. Generally sleeps tolerably; but was much disturbed last
night, by aching pains in the right thigh. Sores are spreading upon
the back; one on the right side beginning to slough. Little uneasi-
ness in the legs and feet, particularly the right; and the latter some-
what œdematous.

Aug. 1. Sensation rather increasing, he passed his water last night,
though unconsciously, without the catheter : urine rather turbid, from
mixture of pus. He is aware when he empties the rectum, but has
no power to prevent it.

  2. Quite conscious when he passes his water; which he does four or
five times a day, without the catheter. After a certain quantity has
accumulated, it flows away. Complains that the pills are too hot for
his stomach.

  6. When placed upon his legs, he can, with assistance, stand.
Every morning, when placed in the erect posture, as much as a tea-
cupful of muco-purulent matter flows from the bladder. It is of a
white colour, extremely fetid; and his water is now constantly drib-
bling from him : the latter is also fetid, and somewhat turbid.

  9. Œdema of the legs increasing. Has partial sensation up the
right leg, but not the slightest motion.

  10. There was retention of urine last night, which caused him
considerable uneasiness. At 11 P.M. the catheter was used; and

about one quart of ammoniacal urine, with admixture of muco-puru-
lent matter, was drawn off; after which, he slept well, and perspired
freely. His back is very uncomfortable, when the poultice becomes
dry : at other times, he has but little pain in it.

Pulse, since his admission, has been natural in frequency, but weak
in power.

The urine, from its odour, appears to contain sulphuretted hydro-
gen. Less muco-purulent matter flows now from the bladder, in the
erect posture.

He takes porter several times in the day.

13. His water never passes without the catheter, and he com-
plains of pain in the back.

14. Stomach very irritable; and he has vomited several times
to-day.

15. There is a considerable sanious discharge from the back : no
pain, except when the bladder is distended. Tongue furred. The
passage of the catheter causes him great uneasiness. The urine is in
large quantity, and evolves sulphuretted hydrogen, which stains the
catheter. A moderate accumulation causes great pain.

Urine to be drawn off three times a day.

19. Last night, the catheter was with difficulty passed, on account
of coagulated blood stopping the urethra. His pulse is 108, thready
and feeble : extremities very cold.

3 p.m. At one o'clock, a rigor came on, which was preceded by
nausea and sickness: it lasted a quarter of an hour, and was fol-
lowed by profuse, cold, clammy perspiration.

Three ounces of brandy seemed to relieve him.

20. This morning he is in a very low exhausted state : pulse 116,
extremely feeble : extremities cold : voice whispering : skin cold and
moist.

21. He spent a very restless night : towards morning, he suffered
from distention of the bladder, soon relieved by the catheter : he now
appears sinking very fast : face cadaveric, and covered with a pro-
fuse sweat.

6 p.m. No radial pulsation : voice almost inaudible. The water
drawn off is of a darker colour, more offensive, and stains the catheter
more deeply than hitherto.

He had no sleep during the night; and sank at half-past five
o'clock next morning, his senses remaining entire to the last.

Mr. King's account of the Inspection is as follows :—

" The body was a good deal reduced. The frame tall and

" bony. The nates had sloughed widely and deeply; and the
" surrounding inflammation was extensive. The skull was
" rather thin than thick; and the brain somewhat small. The
" exterior of the brain only was examined: it seemed natural,
" but for a little opacity and fluid effusion. The heart was a
" powerful organ, and its close serous covering was unequally
" thickened. The liver, spleen, and kidneys did not appear
" healthy. A few points of purulent deposit were found in the
" kidneys : the bladder and ureters were extensively coated
" with sloughy fibrinous adhesive layers, and their surfaces
" were bathed in a sanguineous and puriform secretion.

  " The intervertebral substance, above the twelfth dorsal
" vertebra, with the ligament covering it, presented a slight
" ridge, projecting into the medullary canal, as if an ossifica-
" tion from the edge of one bone tended to unite with a similar
" growth from the opposite edge. This transverse ridge
" manifestly narrowed the canal, as was very evident on
" passing the finger from the wider to the contracted part.
" At this time the arches of the vertebræ and medulla having
" been removed, there was no very visible displacement of
" the bones upon each other; but on making a vertical section
" in the median plane, the fore outline of the spinal canal
" looked as if the under-bone had receded, whilst the anterior
" view of the bodies still offered an unbroken line: and now it
" appeared that the adjoining edges of bone, as well as the
" intervertebral substance, projected into the canal, the promi-
" nence of the last being the most considerable. The prepa-
" ration shews, in addition, in the spinal canal, a degree of
" angular flexure forwards, at the point of disease.

  " The medulla was very carefully examined, but seemed
" quite sound."

  The first of these cases, during the patient's life, impressed
me with the idea of being, in many respects, similar to the
cases detailed by Mr. Stanley; in which paraplegia and dis-
ease of the kidneys existed together. The long existence of
stricture, and a thickened state of bladder, followed by the
sudden attack of paraplegia, led to this suspicion; and I
fully expected to find the opinion confirmed by the post-
mortem appearances. The state of the urine was the only cir-

cumstance that argued against the existence of kidney affection; but when the organs are in a state of confirmed disease, their secretion is sometimes healthy; and the short suspension of the secretion for some hours seemed to indicate a diseased state of the glands. The absence of any morbid appearances, except the very slight points of incipient suppuration, was sufficient to shew that the paralytic affection was independent of the state of the kidneys. The extensive suppuration along the psoas muscle commenced not with the spine, but with the hip-joint; and was equally unconnected with the loss of nervous power. This state of parts was rather the effect of the depressed condition of the nerves of the limb; and had its origin in an old chronic action of the joint, which assumed the destructive or suppurative form as soon as the nervous energy was withdrawn. The ulcerated state of the colon was owing to the same cause—the prostrate condition of the nervous powers. In the latter stages of many protracted diseases, slight causes are found to induce inflammation of the lining membrane of the large bowel, and to be followed by a destructive ulceration. It is probable, from the answers which the patient gave, that the loss of power in the first affected limb had been gradually coming on, before his system began to shew a general disturbance. The fever and delirium, though apparently coincident with the paralysis, were the effect rather of the suppurative action than of the paraplegia.

The cause of the paralysis escaped notice, even after the spinal cord had been examined, until the finger was passed down the canal, and was arrested by the sudden contraction of its antero-posterior diameter at the second lumbar vertebra. The obstruction was found to be occasioned by a projection of the intervertebral substance, or rather the posterior ligament of the spine, which was thickened, and presented a firm ridge, which had lessened the diameter of the canal by nearly a third. When the vertebræ had been divided longitudinally by the saw, the ligament, where it passes over the posterior surface of the intervertebral substance, was found to be ossified nearly throughout the whole of its fibres, and considerably increased in density. The bone formed a bar, uniting the second to the third lumbar vertebræ, and must have been the

result of a long-continued action. The rapid supervention of the paralysis offers no difficulty to this explanation; as the brain and spinal marrow will for a long time bear pressure from other causes, without manifesting symptoms of inconvenience; and will suddenly be overpowered by a paralytic seizure, though the causes may have been gradually coming into operation.

The second case (that of Weeks) differed from the former, in the paraplegia being more slow in its accession, and in the kidneys shewing early signs of unhealthy action. Mr. King, who inspected the body, predicted that the same thickening and ossification of the posterior ligament of the spine would be found, on examination; and his opinion was verified by the result. Instead of the lumbar vertebræ being affected, the twelfth dorsal was the seat of the disorder. The subject of the disease was a bony spare subject of compact fibre, in whom ossification of tissue was to be looked for as a probable occurrence.

Whether, in similar cases, the same cause of pressure on the spinal marrow may have existed without detection, admits at present of no satisfactory answer. Functional paralysis, independent of an obvious cause that admits of demonstration after death, is a state not likely to occur, and not easy to be explained. And, as in the former of the cases, the paraplegia was regarded, at the close of the examination, as arising from functional disturbance alone, it is probable that pressure may have existed, and have escaped observation in those cases which have been classed under sympathetic derangement of function. The occurrence of these cases will serve at least to direct the eye of the morbid anatomist to the state of the spinal canal.

This state of ligament is more likely to occur after the middle period of life, than earlier; the disposition to ossification not being so decided in the young as in the aged. It is not uncommon to find the lower extremities begin to fail at 55 or 60, in persons whose habits of life have been marked by extreme activity, but whose fibre has not been equal to the exertion required; and proceed until they lose entirely the power of walking, or even of resting on their lower limbs. The upper half of the body remains sound; the brain performs its

functions ably to the end; and there is no sign of derange-
ment in any organ or part, save the lumbar portion of the
spinal cord. A medical friend had under his care, during the
past summer, a gentleman who held an important public sta-
tion. He was seized suddenly with a weakness in the lower
extremities, which quickly amounted to entire paraplegia.
His health remained good, and no irregularity or pain could
be detected in any part of the spinal column or cord; nor
was there any reason for looking to the brain as the cause.
His rectum and bladder in a few weeks' began to participate
in the loss of nervous power, which, together with sloughing
of the nates, rapidly destroyed him. Not any satisfactory
cause could be assigned, during his life, for the attack; and an
inspection of the body was not made. This gentleman was a
tall slim man, beyond the middle period of life, of an active
turn of mind and restless activity of body, whose muscles
were not strong, and required the additional aid of the liga-
ments of the spine in supporting the column.

Chronic paraplegia will sometimes seize the robust before
the middle period of life, and will cripple them for years; and
at length condemn them to a permanent state of helpless
paraplegia, and confinement to a horizontal position. This
form is often met with, in all its various gradations, from the
tottering cripple to the complete paralytic. The most dili-
gent examination of the spine, and the most minute inquiry
into the state of the nervous system, fail to elucidate the
cause, either by detecting any thing irregular in the spinal
column, or any organic change in the brain. Such persons
are generally considered to be suffering from softening of
some part of the nervous mass; either the lumbar portion of
the spinal marrow, or of the brain: and because there is not
evidence of any other disease, the period for doing good is
lost. Exercise is prescribed, under the view of restoring
tone to the nervous system, and strengthening the back. The
general health is restored by such treatment; and hope is
entertained that the partial weakness will by degrees yield.
The limbs become more and more weak, until active exercise
becomes impracticable; and the patient is doomed for life to the
state of an invalid. A rigid horizontal position is the only

remedy for such cases, when the state of the general health precludes the suspicion that the weakness of the lower limbs is only part of the general debility. The error, however, cannot be repaired: the pressure on the spinal marrow, though perhaps incomplete, becomes permanent; and its function cannot be restored.

A gentleman, of athletic make and strong constitution, became early in life addicted to the sports of the field, to such excess, that he would frequently pass the whole day in the most active exercise on foot, without taking any nourishment for twelve hours. This was not occasional, but his constant habit at certain seasons of the year. When he reached his thirtieth year, he began to complain of weakness in his limbs, which gradually increased. Of this he thought but little, attributing it to the effects of a former feat of strength, when he was at College—walking on stilts a match of twelve miles against time. The weakness increasing, he endeavoured to walk it off, by taking additional exercise; occasionally having recourse to such medical aid as his neighbourhood afforded. Enjoying the best health with the perfect use of his upper limbs, he now lies in the most complete state of paraplegia, retaining sensation (though not perfect) in his legs, but not any power of motion. A period of seven years has elapsed since his attack commenced. He was subjected during his stay in town to a painful process of extension, which aggravated his sufferings, by causing great pain in his back, without alleviating his malady.

It is not correct to conclude that an alteration in the condition of the ligaments of the spine uniformly produces an unvaried train of symptoms. The ligaments may either become thickened, and cause a temporary pressure; or may become ossified, and induce a permanent compression of the spinal cord: or they may so far be weakened and yield, as to allow displacement of the vertebræ, and absorption of the intervertebral substance. The effects of these derangements are seen by every surgeon, in the course of his practice; though each, in the absence of any decided or defined disease, may have his own view of the case, and assign a different cause for the spinal weakness or paraplegia. The following appears to

me to be a case of yielding of the spinal ligaments, with thickening and consequent pressure, inducing a nearly-complete state of paraplegia :—

A young lady of pale complexion, about 12 years of age, and exhibiting no signs of approaching puberty, began to complain of weakness in the lower half of the body, in walking, and in getting up from a seat. It became gradually worse, and at length she could no longer take walking exercise. Being confined to the house, excepting during the hour of exercise in a garden chair, she was lying on a sofa nearly the whole day, and found that she was losing by degrees the power of moving her legs. She became nearly paraplegic; excepting that she possessed the power of moving the toes of one foot, but no sensation in either of the extremities. It was at this period, after she had been an invalid for 22 months, that I saw her, and examined the spine. There was neither angular nor lateral curvature of the column, according to the usual acceptation of those terms; but there was a general irregularity of the lumbar and lower dorsal spinous processes, which slightly deviated laterally from the straight line. She experienced pain neither on pressure nor on motion of the back. There was no appearance of absorption, nor of ulceration. The horizontal position was prescribed, to be observed with strictness, and a plan of steel medicine with purgatives agreed upon. This mode of treatment was persisted in only for a short period, as the amendment was too slow to keep pace with the wishes of anxious parents. She was placed under empirical treatment; which consisted of extension of the spine, friction, and shampooing the irregular vertebræ into place, together with rigid decumbency. This plan was steadily pursued for ten months, with evident improvement. At the end of four months, she could draw up her legs, and move them down again, with tolerable ease. After ten months' confinement in the establishment, she was pronounced well, and returned home. Here she regained what little power was wanting to enable her to walk; and she now uses her limbs as well as before the attack. Her constitution still remains delicate.

An encroachment on the canal of the spine is necessary

for the production of hemiplegia, when the cause does not exist in the medulla itself. The existence of such pressure is not necessarily accompanied by a corresponding irregularity of the bodies or spinous processes of the vertebræ; and the absence of such deformity, therefore, is not to be considered as a proof of a sound condition of the bones and their ligaments. Neither is pain a necessary condition of ligamentous disease. Pain is the indication, usually, of some irritability of the nervous system, and not of disease of bone or ligament: it accompanies the irritable spine, and is a sign rather of functional disorder in hysteric females or nervous men, than of organic change in the structure of the spinal column. When abscess forms, the distention and pressure produced by the collection of pus causes pain; but if the disease be unattended by suppuration, disorganization of the column may proceed to the production of complete paraplegia, without the patient having experienced any pain in the seat of the diseased action.

A medical student, about 20 years of age, tall, and of large frame, though not robust, complained of weakness in his lower limbs; and experienced some difficulty in going round the wards of the hospital, in the performance of his duties as dresser. In going up the stairs, he suffered great inconvenience, and would take more time than others in reaching the wards; but not so much as to attract the attention of his fellow-students, nor did I notice it as he accompanied me through the hospital. One morning he called on me, with his gait so much crippled, that, on his entering the room, I asked him what made him walk so stiffly. He then entered into the state of his feelings, and described a train of symptoms indicating the approach of paraplegia. He went home; and the same evening a very close and careful examination of his limbs and spine was made by an eminent surgeon, a physician, and myself. Neither irregularity nor tenderness could be detected in any one point of the column; nor had he suffered any pain in any part of the spine at any previous period, except when he was travelling on the Continent in the preceding summer; and he then had some uneasiness in his loins, which was so slight

and so transient as almost to escape his recollection. The recumbent position was enjoined; and soon became necessary, from the gradual loss, first of all power of motion, and then of sensation in the lower half of his body. For two months, no clear indication of the exact seat of disease could be obtained: after which period, a deformity began to shew itself at the upper part of the dorsal vertebræ, which formed so distinct an angular projection, as to point clearly to the cause of pressure. The bladder soon participated in the loss of nervous power, and began to shew signs of disease. He lingered for two years, and died without any external appearance of abscess forming in the course of the spine. Permission for inspection could not be obtained.

It is well known, and not unfrequently occurs in practice, that a very considerable depression, or other irregularity in the line of bones, may exist, without occasioning pressure on the spinal marrow. The deformity termed angular curvature, in which the column is bent forward by a loss of the anterior part of the bodies of the vertebræ, is often witnessed without any injurious effect on the canal. In this form of the disease, the posterior ligament of the bodies of the vertebræ is preserved entire, and the canal therefore remains undiminished in size, though altered in form; and the patient often escapes paralysis, throughout the whole period of this protracted disease, even though ulceration and abscess take place. A displacement of a vertebra may occur from relaxation of ligaments and absorption of bone without ulceration, so as to produce a very perceptible deviation from the natural line of bones, without pressure on the canal, or loss of power in the extremities. The entire vertebra being thrown forward, the canal is altered in form, but not lessened in capacity; and the only effect is a sense of weakness in the part of the spine affected. A total incapability of walking, or even standing without support, ordinarily attends this displacement of bone. The following is a case in which this remarkable deviation in the line of the column ensued. It is not a very uncommon form of disease above the age of puberty.

Mrs. ———, of tall stature and large frame, of light and somewhat delicate complexion, was married in the autumn

of 1834, and passed the following two months after her marriage in rambling on foot and horseback among the mountains of the North. During her excursions, she often complained of weakness and pain in the back, and experienced difficulty of walking. She became pregnant, and a miscarriage was apprehended; but she went the full time, and was confined in June of the following year. After her recovery, she found considerable difficulty in putting her feet to the ground; and on trying to stand, she found she was unable to support herself. The sitting posture was uneasy to her; and it was thought that some laceration might have occurred in her delivery; but none was discovered. For two months she endeavoured to walk; but, as she said she could make no progress, she ceased to make the attempt. A surgeon of experience in her neighbourhood saw her; and considering the weakness to arise from the atonic state of the pelvic ligaments, recommended quiet: she therefore remained without exercise, sitting up, with her feet on the ground. She came to town in April 1836, being then advanced two months in pregnancy. She was able to stand, but not to walk. Her spine presented no irregularity; but she complained of extreme weakness in the back, and with difficulty maintained the erect position.

After her delivery in December following, an examination was made of the spine, and a considerable depression was discovered in the lower part of it. The tenth dorsal vertebra had sunk, so that its spinous process, instead of projecting, was depressed much below the level of the others. The vertebræ, both above and below, were in their natural states; the irregularity being entirely confined to this one bone. There was not the least tendency to paralysis; the sensation being perfect, and the power of moving her lower limbs being unimpaired; but the act of sitting was distressing to her, from the strain in the back; and the erect position was impracticable. The entire vertebra must have advanced, carrying with it the spinal marrow: the arch of the canal, with the spinous process, could not alone have changed its position, without pressing on the spinal cord: and if the body of the vertebra had undergone absorption anteriorly, the two contiguous vertebræ would have altered their axes, and

their spinous processes would have been thrown apart. The peculiar deformity must have been caused by the absorption of the intervertebral substance and the yielding of the ligament, allowing the whole vertebra to advance. The plan adopted for her recovery is, the strict adherence to the recumbent position. She is now again pregnant; and the effect of the treatment is therefore for the present suspended. There is no reason to apprehend an unfavourable issue to the cure, if the health remain good, and the system of recumbency be strictly attended to.

This yielding of the ligament, from weakness of fibre, is different in some respects, both in its effects on the individual, and in its nature, from that which induces paralysis: but the difference is attributable to the age of the patient.

These two forms of disease are not so wholly opposed to one another, as at first they might seem to be. In both, the action takes place in the posterior ligament of the bodies of the vertebræ; and the causes, acting in both cases, is an overstraining of their fibres. Their relative effect is modified by the tendency in the individual, depending on age, and other peculiarities of system. In the aged, a disposition to thickening and ossification of tissue usually prevails; the arteries become ossified; the joints anchylosed; the cartilages supplanted by bony deposit; and the fibrous tissue generally shews abundant signs of the tendency to ossific deposition. Among persons therefore advanced beyond the middle period of life, an unhealthy or feeble condition of the ligament of the spine is productive of bony effusion; as is frequently seen along the anterior spinal ligament, and intervertebral substance, which present a bony ridge, and induce a permanent bony anchylosis of several vertebræ. The occurrence of this conversion into bone of the anterior ligament probably saves the posterior from a similar action, by taking off the strain from the latter. These two ligaments, performing contrary functions, will not be affected by the same causes; and therefore one will be found diseased, while the other remains sound.

The over-extension of ligament, which in the aged is followed by rigidity and ossification, is productive, in the young,

either of inflammatory swelling, or of yielding of its fibre
and absorption. The disposition to ossification is as rare in
the young as the yielding of ligament is in the old; and the
same cause, therefore, will give rise to different effects, ac-
cording to the period of life at which diseased action is brought
into operation. In the young and strumous subject, a low
degree of inflammation ensues, productive of thickening and
swelling of the posterior spinal ligament; and a consequent
pressure on the cord, giving rise to temporary paralysis : or,
if it proceed to ulceration and suppuration, the paralysis often
becomes permanent, and the life of the patient falls a
prey to the disease. In persons of more laxity of fibre, but
indisposed to inflammation, the ligaments yield, and become
absorbed; thus saving the cord from pressure, and only dis-
abling the powers of the spine, as a column of support. There
is some analogy between the ligaments of the spine, under
diseases of a strumous character, and those of the joints.
When ligaments are strained or stretched by over-exertion,
in young persons of lax fibre, the consequences are not sud-
den pain and swelling—as usually follow in violent sprains
incapacitating the joint, and rendering the limb powerless ;
but a more chronic action ensues, in which inflammation bears
no very prominent part. A sense of weakness follows, but
no pain. A yielding of the ligament takes place, and, pro-
bably, a solution of continuity in some of the fibres; but the
person is not disabled from using the limb, or from walking
upon it, when the lower extremity is the seat of disease. The
weakness induced by the yielding of the fibres at length im-
pairs the functions of the joint; and a slight limping follows,
but not accompanied with pain. The swelling of the liga-
ment adds but little to the inconvenience, so long as suppura-
tion is prevented.

This tumefaction of ligamentous structure is met with in
almost all the hinge-joints. The ancle, elbow, and knee joints
are especially liable to become the seats of these swellings.
They are formed on the surface, or sometimes in the tissue of
the dense fibrous ligaments; and appear as circumscribed
tumors, of a circular form, and usually not exceeding in size a
small chesnut. The skin over them remains undiscoloured,
so long as inflammation is prevented. They feel pulpy, as if

containing a cheesy matter; and are often incautiously punctured, unless the surgeon is aware of their nature. If cut into, in the early stage, and pressed firmly, a whitish, and in some parts a vascular fungous mass is forced out; which appears to be organized, and therefore unlike ordinary tubercular or scrofulous deposit, which is a mere effusion of an unhealthy fibrin.

These swellings remain indolent for months, and, by improving the general health, will sometimes become stationary in growth, and at length absorbed. But if the constitution be enfeebled by natural causes, or by habits of dissipation, their course towards suppuration is slow, but certain. The skin inflames, and ulcerates; and the pus, which is usually not abundant, escapes. The swelling does not, however, subside: the mass, being formed principally of swollen ligament, with interstitial effusion, remains, and furnishes a long-continued but scanty purulent secretion. At length, the subjacent synovial membrane ulcerates, and the cavity of the joint is opened. This is announced by an escape of synovia, which is perceptible on the dressings, and possesses its usual colour and consistence. The integrity of the joint being thus disturbed, a more active and more serious destructive process, in the form of ulceration of the articular cartilage, often follows. Sometimes, however, the cavity of the joint again closes; and a firm and permanent process of restoration taking place, it is preserved from further injury. This more favourable termination of the ulceration is the exception to the ordinary course of the disease. Usually, the joint becomes permanently involved.

It is obvious that the opportunities of verifying, by dissection, such a morbid state of the posterior ligament of the vertebræ must be rare. The chance of a *post-mortem* examination can occur only when death takes place from another cause. If paralysis, from pressure on the spinal marrow, is produced by it, a fatal termination is not likely to follow, until suppurative ulceration and its consequences ensue; in which case, all vestige of the original commencement of the disease will necessarily be lost, in the general destruction of bone and ligament. The spine will then present the usual appearances of caries arising from scrofulous action,

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with the slight difference of the disease having commenced in
the posterior part of the spinal column.   If the symptoms of
pressure on the marrow cease, the opportunity of ascertaining
the cause of the paraplegia does not present itself; and often
its nature will therefore remain in obscurity, and will rest
for explanation on the analogy between this and other
forms of strumous action.   The occurrence of paraplegia in
the earliest stage of the disease, before the spinous processes
exhibit, by their altered form, any change in the bony
column, is often found to attend ulceration of the vertebræ,
when the ravages commence in the posterior parts of the
bones towards the vertebral canal.   Early participation in the
disease either causes the posterior ligament to become thick-
ened, and press on the cord; or its early destruction removes
the support of the bones, and allows them to press on the
spinal canal.   In either case, partial paralysis is one of the
earliest symptoms.

To enter minutely into the various forms of disease to which
the spine is subject, would require a space which the limits
of a Paper will not allow ; and would be foreign to the purpose
that I have in view, in writing the preceding observations.
I have had occasion to see many cases of paraplegia, either
complete or partial, in which the cause has been so obscure,
that no satisfactory conclusion could be arrived at: or in
which the opinions delivered on the nature of the cause are so
much at variance with each other, and with the facts of the
case, that some further investigation of the subject seemed to
be required.   The facts here detailed, with the inferences
drawn from them, will at least serve to elucidate some of the
causes of paraplegia, and to remove some of the obscurity
that surrounds spinal pathology.   I am inclined, by long ob-
servations of spinal affections, to think that the ligaments
are more frequently in fault than any of the structures of the
spinal column; and that many of the cases of paralysis,
whether temporary or permanent, and vaguely classed under
functional derangements of the spinal cord, will be found, by
dissection, to depend on an altered condition of those tex-
tures.

RESEARCHES

INTO

THE CHEMICAL NATURE

OF

MUCOUS AND PURULENT SECRETIONS.

BY GOLDING BIRD, F.L.S.

The difference existing between purulent and mucous secretions has long occupied the attention of the chemist and physician; but, owing in all probability to the very imperfect state of our knowledge of animal chemistry, little very satisfactory has been hitherto elicited. In our own country, Dr. Pearson* has been the only chemist who devoted much time to this subject; and his very interesting and important paper on Expectorated Matter remains on record as a monument of talent and industry, exhibiting an acquaintance with physiological chemistry truly surprising, when we recollect the date of its publication. The great majority of chemists, who have paid any attention to this matter, have been inclined to consider mucus and pus, together with all forms of membranous secretions, as combinations quite peculiar; and indebted for their characteristic properties to the presence of a peculiar proximate principle, less than to the combination of an already well-known substance, derived from the blood, with some organic or saline matter; serving at once to communicate properties fitting it for the office it has to serve in the animal economy, and to cause that alteration in its physical properties which disguises it from the researches of the chemist. Darwin, Hunefeld, and others, have devoted some time to this subject; less, however, with the view of adding to our stock of information in a physiological point of view, than for the more limited purpose of ascertaining some mode of distinguishing pus from mucus, as assisting in the diagnosis of pulmonary affections. In consequence, however, of the ignorance existing on the true chemical nature of the various

* Philosophical Transactions 1809, page 313.

secretions peculiar to the air-passages, the tests that have been proposed are for the most part fallacious, and utterly unworthy of confidence. It is extremely fortunate, indeed, that the introduction of auscultation has rendered these tests of much less importance than they were considered to be twenty years ago; as even the refinements of modern chemistry have, as yet, promised but little towards putting us in possession of indications strictly pathognomonic of the various forms of thoracic disease.

Mr. Brande, in a paper published in the Philosophical Transactions for 1809*, first demonstrated the existence of albumen in saliva and mucus; in which secretions it was not then suspected, nor is it even now believed, by many, to exist: and it is a matter of regret that this philosopher has not followed up these views; as, from researches guided by his talent, much might have been expected. This paper of Mr. Brande's seems never to have attracted that degree of notice which it deserved; but I trust that the attention of chemists will be directed to it, and the correctness of his views canvassed.

In the winter of 1836, I presented to the Physical Society of Guy's Hospital a thesis on pathological chemistry; in which, when speaking of mucous secretions generally, I hazarded the opinion, that they were indebted for their peculiar properties to the presence of *combined* albumen: suggesting, also, that the combination consisted, in all probability, of an *alkaline albuminate*. Afterwards, in continuing my investigations, the remarkable solvent action of carbonic acid on coagulated albumen† fell under my notice; by which I became acquainted with a series of albuminous solutions not previously known to exist, which presented, under certain circumstances, phænomena similar, if not identical, with those presented by mucus. This discovery strengthened my former opinion; but still, as there were many peculiarities of mucus which I was unable to explain, I refrained from publishing my researches; when the paper of Dr. Babington appeared, in the last volume of these Reports. Several of these diffi-

* Page 373.

† Vide London and Edinburgh Philosophical Magazine, vol. for 1836 and 1837; and Medical Gazette, vol. for 1836.

culties were there removed; as it contained a piece of infor-
mation (and an exceedingly valuable one it is), of which, in
common, I believe, with most other chemists, I had been pre-
viously ignorant. I refer to the remarkable action of neutral
salts on a mixture of soluble and insoluble albumen, as pus
—a fact previously unknown, and almost unsuspected; and
which, simple as it appears, now that it is demonstrated, is, in
my opinion, one of the most important in physiological
chemistry that has been published since the time of Pearson.

I trust that I shall not be considered too presumptuous in
now submitting the results of my experiments to the notice
of the physiologist and the chemist; having, I venture to be-
lieve, with the assistance of Dr. Babington's discovery, com-
pleted those links in the chain of evidence which were required.
I am far from presuming, however, that my experiments are
sufficient to set at rest the various opinions that have been
broached on the nature of purulent and mucous secretions;
but I trust that they will serve to draw the attention of
other observers to this subject, and no longer allow it to re-
main, as it has too long been, the opprobrium of physiological
chemistry.

A.—*Chemical characters, and analysis of mucous and purulent
secretions.*

1. Before we are enabled to appreciate the changes pro-
duced in albumen by the action of re-agents in our synthesis
of mucus, it is absolutely necessary to become acquainted
with the physical and chemical properties of those secretions
we are attempting to form or imitate: and as no experiments
of this kind are on record, excepting those of Dr. Pearson,
I trust no apology will be considered necessary for the in-
troduction of this section, although at the risk of extending
this paper beyond its intended limits. The only form of
mucous secretion which has been quantitatively examined, is
that from the nostrils: this, when first secreted, appears to be
a very fluent liquor; and owes that viscidity, which we are
accustomed to consider as peculiar to it, to the loss of its
aqueous parts by evaporation; it being necessarily exposed to
a fresh current of air during each inspiration. According to
Berzelius, 100 parts of nasal mucus consist of

Peculiar mucus 5.33
Alcoholic extract, alkaline lactates .... .30
Chlorides of sodium and potassium .... .56
Aqueous extract, albumen, and phosphates .... .35
Soda combined with mucus .... .09
Water 93.37
                                        ──────
                                        100.

In this analysis, we find that 5.33 per cent. of *peculiar mucus;* and .09 per cent. of mucus combined with soda, are stated by Berzelius to be present. But, with the utmost deference to that illustrious chemist, I must venture to suggest that this peculiar mucus is one of those combinations of albumen mentioned by Dr. Babington; and of which I shall speak more at length in another part of this paper.

2. The minute proportion of free albumen, set down in this analysis as forming one of the constituents of mucus, most probably arises from a slight admixture of tears, which are constantly flowing into the nostrils: for, on examining any of the other varieties of simple mucus, not the smallest trace of free albumen (*i.e.* in a state coagulable by heat, nitric acid, ferrocyanide of potassium, &c.) can be detected, by any of the ordinary re-agents for that substance: although this must not be regarded as a proof of its absence; for it must not be forgotten, that it may exist so combined as to be no longer affected by the usual tests. That such combination may be readily formed, may be proved by mixing acetic acid with serum of blood, and boiling the mixture: a part only of this albumen will be coagulated; and, on throwing the mixture on a filter, a limpid fluid passes through, from which neither heat nor most acids cause any separation of albumen; although it is obvious that a considerable quantity of that principle must be present in solution. Similar results are obtained if potass or soda, dissolved in water, are substituted for acetic acid. These, and other analogous * experiments, are sufficient to

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* " Parmi toutes les réactions des acides sur l'albumine, il en est une extrèmement importante par les circonstances illusoires qu'elle peut prêter aux analyses en grand des substances organiques: non seulement certains acides, tels que l'acide acétique, dissolvent l'albumine, *mais encore ils la rendent soluble dans l'alcohol, et dans l'eau bouillante, en des proportions fortement appréciables*." Raspail, Nouv. Syst. de Chim. Org. p. 201.—" Gegenwart von Kali oder Natron verhindert das Gerinnen (des Eiweisses) &c." Moldenhauer. Grundriss der Chemie,

prove that albumen may exist in solution in a state not easily
to be detected by the usual re-agents. Still more remarkable
changes are produced by merely acting on some solid forms
of *organized* albumen, as hoofs, nails, hair, &c., by boiling
water; a new substance altogether being generated (*gelatin*),
in which we can no longer recognise any of the characters of
albumen.

3. As a type of mucous secretions from the air-passage as
free as possible from purulent admixture, I think that that
secreted during the first few days of acute catarrh or bron-
chitis may be taken. This form of mucus, which is identical
with the second kind of Dr. Pearson, appears at first to be
rather opaque, from the presence of innumerable air-bubbles;
but, by repose in a cylindrical vessel, these rise to the surface,
and a nearly limpid glairy fluid is obtained: this does not
coagulate by heat, and presents the following peculiarities
with re-agents :—

A. On the addition of sulphuric acid, a reddish-brown
solution is formed; which, by dilution with water, loses its
colour, and *becomes quite transparent.*

B. Nitric acid appears at first to coagulate it, rendering it
yellow in patches; and, by the assistance of heat, forms a pale
yellow solution, becoming brown on the addition of an alkali.

C. Hydrochloric acid removes the slight turbidity it pre-
viously possessed, and *causes it to assume a lilac tint.*

D. Ammonia, by the assistance of heat, partly dissolves it;
forming a gelatinous solution, becoming turbid when diluted
with water.

E. Acetic acid produces a partial coagulation; causing the
mucus to assume the appearance of a corrugated membrane
floating in the acid.

F. Infusion of galls *produces a copious precipitate.*

G. A quantity being evaporated to dryness, left a gum-
like residue; which, when carefully incinerated in a platinum
crucible, yielded a perfectly white ash, destitute of all traces
of iron: it turned turmeric-paper brown; and partly dissolved

Chemie, abtheilung 2te. s. 430.—See also Berzelius, Traité de Chimie, tom.
VII. p. 68. Thénard, Traité de Chimie, tom. IV. p. 361. Bouchardat, Cours
de Chimie, p. 513, &c.

in acids, with effervescence; demonstrating the presence of an alkaline carbonate.

Upon a review of these experiments, we find none of the phænomena hostile to the opinion of the presence of albumen: indeed, some of them (*B, C, F*) appear to indicate its existence. The action of acetic acid (*E*) is quite peculiar to that combination existing in mucus; to which I shall again have occasion to refer.

4. When nearly limpid mucus possessing the above properties is kept for a few days exposed to the air, it becomes turbid, and gradually lets fall a white cream-like deposit; the whole assuming the physical characters of that kind of opaque mucus secreted in the more chronic stages of bronchitis. Some of this cream-like deposit was collected and examined: it presented, under the microscope, the appearance of numerous roundish particles, which were readily recognised as coagulated or insoluble albumen; for it dissolved in hydrochloric acid, yielding a fine lilac-coloured solution; in nitric acid, with the aid of heat, it formed a yellow fluid, becoming brown on the addition of potass; and with acetic acid, it yielded a colourless solution, from which ferrocyanide of potassium threw down a pale yellow precipitate *in the cold**.

Having thus proved this deposit to consist of albumen, a most interesting question arises as to its source; for, as has been already shewn (3), none of this principle could be *absolutely proved* to exist in the mucus before exposure to air, however much its presence might have been suspected. My first suspicions were, that the carbonic acid of the atmosphere had been the active agent, by combining with the substance which previously held the albumen in solution: this appeared to be probable, as some experiments, which it is unnecessary to detail, seemed to countenance the idea of the existence of albuminate of soda in mucus. I accordingly placed a glass filled with the same limpid mucus under a jar of hydrogen gas, and in a few days the same creamy deposit appeared, as

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* It is important, whenever this re-agent is used for the detection of albumen, *that heat should never be employed;* as even the purest specimens of acetic acid, that I have met with, produce a troubling, when heated with the ferrocyanide.

when exposed to the free air ; hence proving, satisfactorily, that the absorption of carbonic acid is not necessary for producing this curious change.

5. When simple, limpid mucus is boiled in a test-tube, no coagulation, as already stated, takes place; but on prolonging the ebullition, a milkiness appears, and after a few minutes an insoluble opaque deposit ensues. This change is best observed by heating two or three ounces of the mucus, over a lamp, in a glass basin : the deposit is then more distinct, and by repose it becomes considerable : on examination, it is found to consist of albumen in amorphous particles, in which alone it differs from that precipitated from mucus by exposure to the air or to an atmosphere of hydrogen. This change has been mentioned by Dr. Pearson*, although he did not examine the nature of the deposit.

6. The next variety of mucous secretion which it is neces-sary to examine is that termed purulent or puriform mucus, secreted copiously during chronic bronchitis. This is gene-rally very opaque, often containing greenish masses, exceed-ingly tenacious; so that on attempting to pour it from one vessel to another, instead of falling in drops, it forms one con-tinuous rope, sometimes two or three feet in length, which is absolutely sectile. It usually contains innumerable air-bubbles, which are evolved with difficulty : it can be scarcely said to be miscible with water, on account of its excessive tenacity. I have already mentioned its resemblance to simple mucus concentrated by evaporation, after having deposited part of its combined albumen by exposure to air. The behaviour of purulent mucus with various re-agents, therefore, exactly resembles what we should, à priori, expect from operating on simple mucus, having numerous minute particles of insoluble albumen in intimate diffusion. In general, I have observed this variety to exert a faint but distinct alkaline re-action on syrup of violets, and paper tinted with infusion of rose-petals : after a few days' exposure to the air, this effect becomes still more obvious. I mentioned this circumstance in my Essay†

* Phil. Trans. 1809, p. 322.

† Essay on Pathological Chemistry, par. 57 (note) ; now deposited in the Library of Guy's Hospital.

(before alluded to), but with considerable caution, as it was opposed to generally-received opinion; but I now feel much more confident, as this fact has been corroborated by the experiments of Dr. Babington*.   The globules or particles of insoluble albumen present in puriform mucus are sufficiently obvious, under a moderate magnifying power.   When acted on by re-agents, the following were the results:—

A. Sulphuric acid formed a pale reddish solution with purulent mucus; remaining nearly transparent, after dilution with water.

B. Nitric acid dissolved it with great difficulty, and not until after the application of heat: a pale yellow solution was then obtained, becoming orange-red on the addition of a solution of potass.

C. Ammonia, by the assistance of heat, yielded a turbid solution: when this was poured into cold water, it formed, after a few seconds' repose, a thin layer on the surface; which, when viewed from above downwards, appeared quite diaphanous; but when placed horizontally between the eye and the light, appeared like a layer of semi-opaque jelly: this, after some time, subsided, in a manner closely resembling the subsidence, of silicic acid, from hydrofluosilicic acid, after the addition of a potass-salt.

D. Hydrochloric acid partly dissolves puriform mucus, forming a lilac-coloured troubled fluid.

E. Acetic acid did not dissolve it, even after the application of heat: it appeared to contract the mucus into a corrugated membranoid mass, which floated on the surface of the fluid.

* Guy's Reports, Vol. II. p. 539.

If any proof was required of the alkaline state of many mucous secretions, I would cite the case of mucus discharged from the bladder during the irritation of calculous or prostatic disease: this secretion is always alkaline, even when the supernatant urine is neutral, or even faintly acid.   For this very interesting observation, demonstrating in a satisfactory manner the fact of an alkaline fluid resting at the bottom, or even diffused through a faintly acid one, without the neutralization of both, being the necessarily *immediate* result, I am indebted to my friend Mr. Edward Cock, who has verified it in several instances. To Sir B. Brodie must be accorded the credit of *first* pointing out this highly interesting and important fact.   My friend, Mr. Richard Phillips, lately informed me that he had been long aware of this circumstance, having demonstrated it in the saliva by means of cudbear paper.

F. By careful incineration in a platinum crucible, a *nearly white* ash was obtained; which exerted an alkaline action on turmeric paper, and partly dissolved, with effervescence, in dilute acids.

It is unnecessary to make any remark upon these reactions, as they resemble those produced by simple mucus, modified only by the presence of particles of free albumen.

7. With the view of ascertaining the presence of any previously unsuspected solvent of albumen in mucus, the following experiments were performed :—

A. Some ounces of rather opaque mucus of bronchitis were placed in a flask furnished with a tube bent twice at right angles, and immersed in lime-water. A lamp-heat was then applied to the flask ; and in a few minutes, long before actual ebullition, bubbles of gas were copiously evolved from the mucus ; and on passing through the lime-water, they rendered it quite milky, *from a copious deposit of carbonate of lime ;* hence proving, most satisfactorily, the presence of carbonic acid in mucus, either free, or in so loose a state of combination, as to be evolved by a very gentle heat.

B. Two fluid-ounces of the same specimen of mucus were mixed with a small quantity of a solution of potass, in a flask furnished, as before, with a bent tube, the end of which was immersed in a small quantity of pure dilute hydrochloric acid. On applying heat to the flask, the upper part and tube became soon filled with white fumes ; and after five minutes' boiling, the lamp was removed: the dilute acid being carefully evaporated to dryness in a glass capsule, yielded numerous delicate feathers of hydrochlorate of ammonia. To obviate any source of fallacy in this experiment, some of the *same* specimen of diluted hydrochloric acid was evaporated to dryness ; but scarcely the minutest traces of residue were visible, even with the aid of a lens. By simple distillation without admixture, mucus (as was stated by Dr. Pearson) does not yield the smallest traces of ammonia : hence we may very safely conclude, that although mucus does not contain free ammonia, yet that it contains a salt of that base, most probably the chloride (muriate of ammonia); a salt which the

ingenious researches of Raspail have proved to be universally present in animal fluids[*].

8. The chemical characters of pus next claim our attention : these have been much better understood than in the case of mucous secretions. Pus differs but slightly in its characters, when obtained from secreting surfaces in different parts of the body : that, for example, expectorated in the last stages of phthisical disorganization, or during the natural cure of an empyema, differs from that obtained from an abscess only in the occasional presence of bronchial mucus. For the purpose of examination, I procured about a pint of the fluid expectorated by a lad in Naaman's Ward, who was affected with empyema, discharging itself by an opening into a bronchial tube. This expectorated matter, by repose in a glass cylinder, separated into three layers : the lowermost was nearly limpid, exceedingly viscid, and presented all the characters of ordinary bronchial mucus. The central layer appeared nearly homogeneous, of a greenish yellow colour, feeling greasy when pressed between the fingers, evolved an odour of sour milk, and, indeed, possessed all the physical characters of ordinary pus. The superior layer resembled the central one, but contained an immense number of masses, resembling lumps of coagulated albumen, of a greenish-yellow colour : besides these, there was a large, shapeless, tough mass of albuminous matter, semi-transparent at the edges, and of a yellowish colour : this was supposed to have been the plug which closed the opening into the bronchiæ, prior to the last gush of matter from the pleural sac. The central layer of the expectorated fluid having been separated by means of a siphon, was strained through a piece of fine canvas, and submitted to the action of re-agents.

. *A.* Under the microscope, it presented the usual appearance of innumerable roundish particles, floating in a colourless fluid.

B. On the addition of a drop of sulphuric acid, the pus readily dissolved, forming a pale reddish solution, which, on

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[*] Nouveau Système de Chimie Organique, pp. 195, 346, &c.

dilution with water, *became white and turbid, resembling a mere mixture of pus and water.*

C. Nitric acid caused it to assume a yellow tint, and, with the aid of heat, dissolved it entirely, forming a clear lemon-yellow solution, which, on the addition of an alkali, assumed an orange-red tint.

D. Hydrochloric acid partly dissolved it, causing the whole to assume a pale lilac tint: a deposit of the same colour fell in a few minutes, which, under the microscope, appeared to consist of masses, with rounded edges, apparently composed of innumerable contracted globules.

E. Ammonia produced no immediate effect, but, after agitation for a few seconds, formed with the pus a semi-translucent gelatinous mass.

F. Some of the pus was mixed with distilled water, and thrown on a filter: a limpid fluid passed through, which coagulated by heat, and was found to consist of a dilute solution of albumen, resembling dilute serum of blood. The insoluble matter left on the filter consisted of particles of coagulated albumen.

G. The insoluble residue left on the filter, in the last experiment, was ignited in a porcelain crucible over the spirit-lamp with double current of air: the carbon was got rid of by moistening the ash with nitric acid, and again igniting it. A brick-red ash resulted: this was boiled in hydrochloric acid, diluted with water, and filtered : the filtered fluid yielded a brown precipitate with ammonia; a blue, with the ferrocyanide, and a crimson with the sulphocyanide of potassium; demonstrating the existence of a large quantity of iron in pus.

9. From the above experiments, it is evident, that whilst pus resembles puriform mucus in the presence of particles of insoluble albumen (which exist in much larger quantities in the former than in the latter), it differs from both varieties of mucous secretion, in containing a large quantity of free albumen in solution, in a state coagulable by heat, acids, and its ordinary precipitants. On the other hand, pus very closely resembles blood; like that fluid, containing large quantities of globules of albuminous matter in diffusion, as well as in containing a serum, or aqueous solution of albumen: it

differs most essentially from blood, in the absence of that phy-
sical arrangement, or vital disposition of its particles, neces-
sary for the production of spontaneous coagulation*, as well as
in the nearly total absence of hæmatosine, or red colouring
matter; although it possesses one striking (and formerly
considered essential) property of that animal principle, viz.
the presence of a large quantity of iron; in which it again
differs most materially from mucus.

* I trust that I have expressed myself with sufficient caution to avoid mis-
conception. I have purposely omitted the word *fibrin* in the above summary,
because (as far as my knowledge extends) it does not differ from insoluble or
coagulated albumen, excepting in the physical arrangement of its particles
fitting it for the important part it has to play in the animal economy.
All supposed differences between fibrin and albumen depend entirely upon
physical molecular arrangement: for I repeat, *that there is not a single
chemical re-action in which those white masses of albumen found in the large
vessels after death* (formerly called polypi), and which may be assumed as fair
specimens of fibrin, *differ from coagulated white* of egg, or serum of blood.
The supposed chemical differences between the amorphous and fibrous forms
of coagulated albumen were published at a time when animal chemistry could
scarcely be said to exist as a science; and it is time that chemists should cease
to copy these errors from each other.   Berzelius states : " A l'état de coagu-
lation, l'albumine posséde *si complètement toutes les propriétés chimiques de la
fibrine, que je ne pourrais pas citer une seule des propriétés dont j'ai parlé, a
l'occasion de cette dernière, qui ne s'applique tout aussi exactement a l'albumine.*"
Traité, tom. VII. p. 73.—Bouchardat observes, that " Toutes les propriétés de
la fibrine s'appliquent, pour ainsi dire, à l'albumine coagulée, sans même en ex-
cepter celle indiquée pour la première fois par Caventou et Bourdois, &c.". . . .
" et il serait difficile de concevoir cette similitude si parfaite dans la manière
de se comporter, autrement qu'en admettant que les deux substances n'en
constituent qu'une seule et même sous le point de vue chimique, et *ne diffèrent
l'une de l'autre que par quelque circonstance accessoire* peu importante, mais
encore inconnue." *Cours de Chimie*, p. 516. — Even Thenard, who seems in-
clined to contend for the distinction between coagulated albumen and fibrin, is
able to mention but a single circumstance in which any material difference
exists, viz. in fibrin when dropped into oxygenated water $(H + 2O)$ disengaging
oxygen, which coagulated albumen does not: this is, however, a distinction
without a difference, depending entirely, as Berzelius observes, upon the shape
of the particles immersed ; for " les corps ronds, et dont la surface est lissé, ne
dégagent point de gaz des liquides qui en sont chargés, tandis que les corps
pointus, raboteux, anguleux, chassent le gaz de la liqueur par leur surface."
Traité, tom. VII. p. 73.
    Moldenhauer, after detailing the results of the dry distillation of fibrin,
states : "In seinen übrigen Eigenschaften stimmt der Faserstoff mit dem
                                                            Eiweiss-

By quantitative analysis, I found 1000 grains of pus, sp. gr. 1.0409, procured from a psoas abscess to consist of

Water 898.00
Aqueous extract (alkaline lactates) 8.00
Alcoholic extract (fatty matter) 5.00
Chlorides of sodium and potassium, with alka-
   line carbonates resulting from the decompo- } 5.75
   sition of lactates ....
Albumen 75.75
Phosphates of lime, and iron with oxide of iron   7.50
                                      1000.00

10. It would be wrong to quit this part of my subject, without mentioning the remarkable results obtained by submitting mucous secretions to the action of electric currents of various intensities; especially as they serve to corroborate, in a remarkable degree, the opinions before advanced, of the constant, and indeed necessary presence of albumen, although in a disguised state, in that class of secreted fluids. Mr. Brande, as I have already stated, was the first chemist who submitted albuminous fluids to the action of electric currents: his experiments are detailed in full, in the Philosophical Transactions for 1809. This philosopher states, that whenever an albuminous fluid, as white of egg diluted with water, is traversed by an electric current of considerable intensity, coagulation takes place at the negative electrode; and that when mucous secretions, as saliva, mucus of an oyster, &c., are submitted to the action of a similar current, a deposition of coagulated albumen invariably occurs at the negative side of the battery. This result is more particularly interesting, in consequence of the nearly total failure of the ordinary chemical re-agents in detecting its presence in these secretions: from which Mr. Brande concludes that a voltaic current is the

Eiweiss-stoff sehr überein, und ist diesen auch ähnlich zusammengesetz." *Grundriss der Chimie,* 2te Abtheilung, s. 435.

I shall close this list of authorities—which I trust will be considered sufficient to corroborate and support the remarks I have made on the identity of albumen (coagulated) and fibrin—with the apt, although not very courteous remark of Raspail on this subject :—" La Chimie ancienne, fidelle aux principes qui lui servait de base, *s'obstinait a vouloir trouver des différences entre deux substances identiques,* mais obténues de deux organes différens." *Nouv. Syst. de Chim. Org.* p. 202.

most delicate test we possess for the detection of albumen. I have repeated, on an extensive scale, all the experiments of Mr. Brande; and varied them, in various ways. My results were nearly identical with those obtained by that gentleman, 28 years previously. The only material discrepancy consisted in the coagulation of albumen occurring, in my experiments, at the positive electrode; whereas, in Mr. Brande's, it took place at the negative. This discrepancy admits, however, of a ready explanation: but as this is a strictly chemical question, I may be allowed to refer, for a full account of my experiments, to the London and Edinburgh Philosophical Magazine for 1836-7; or to M. Becquerel's Traité de l'Electricité et du Magnétisme, vol. V. p. 293 et seq. It may be sufficient to state, that bronchial and vesical mucus invariably afforded copious indications of the presence of albumen: of this, any one may satisfy himself, by dipping into either of these secretions, placed in a wine-glass, two platina wires, connected with a battery of six or eight pairs of plates, excited only by salt and water. The same results are obtained when but a single pair of plates, properly arranged*, is employed, provided sufficient time is allowed— two or three hours being required; whereas as many minutes are sufficient to cause a copious albuminous precipitate, when six or eight pairs of plates are used.

To these experiments it may be objected, that the albumen, instead of being separated by electric action, is actually *formed* at the expense of the animal matter present in mucus: but this objection can scarcely, I conceive, be regarded tenable, when we recollect the exceedingly low tension of the electric current employed in most of my experiments.

B.—*Results obtained from the attempted synthesis of mucous fluids.*

11. The action of alkalies and neutral salts on pus has been long proposed as furnishing a test to distinguish that secretion from mucus; but their curious effect, in producing an approach to the artificial synthesis of mucus, has never

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* Such an arrangement I have described in a paper read before the Royal Society, Feb. 1837; and published in the volume of the Philosophical Transactions for that year.

been observed, as far as I am aware, previously to the publication of Dr. Babington's paper.   John Hunter added a solution of hydrochlorate of ammonia to pus, and found that it induced its *coagulation*—a term that ill expresses the change that really occurs.   Dr. Darwin, junior, observed, that caustic potass, added to pus, converted it into a stringy substance, resembling the mucus discharged from the bladder, in certain diseases of that viscus.   Grasmeyer noticed the action of carbonate of potass on pus; which was analogous to that produced by the pure alkalies, but required a longer time for effecting it.   None of these observers, however, followed up these facts by other experiments; and those who have since written on this subject have, for the most part, contented themselves with mentioning, without repeating or extending them.

12. After having ascertained, by direct experiment (4), the fact of the presence of albumen in mucus, as well as the high probability of its being the chief organic constituent of that secretion, I endeavoured to discover some modification of this principle, which, in its several properties, would approach the animal matter found in mucus.   In consequence of the constant, although faintly alkaline state of this secretion, I attempted, by combining albumen with alkalies in different proportions, to effect its conversion into a mucoid substance. These experiments, although interesting, in consequence of their eliciting much information on the chemical properties of albumen, yet failed in effecting the formation of mucus.   As most of the results obtained have been already published, it is unnecessary to mention more than one or two of the most interesting.   In general, it may be observed, that although several alkaline albuminates resemble the animal matter of mucous fluids in many of their properties, yet they differ essentially in others; as the following experiments serve to shew.

13. Some fresh serum of human blood, previously agitated with ether to separate its fatty ingredients, was mixed with a solution of pure soda, until the whole became strongly alkaline.   On the application of a gentle heat, the mixture gelatinized, forming a mass resembling a straw-coloured jelly; water was then added, and a boiling heat applied for a few minutes: it did not coagulate; it scarcely affected the most delicate vegetable colours; and, indeed, presented all

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the re-actions of a tolerably pure albuminate of soda. The fluid thus obtained, frothed on slight agitation, could be drawn into threads between the fingers, and was rendered turbid by nitric acid, like so much bronchial mucus; from which, however, it differed, in its not being rendered opaque by protracted ebullition, nor by exposure to an atmosphere of hydrogen gas; and in the precipitate produced by acetic acid being pulverulent and soluble in an excess of the precipitant, instead of the insoluble *membrane-like* mass peculiar to mucous secretions. The existence of these discrepancies, together with the comparatively small quantity of alkaline carbonates obtained by incinerating mucus, tended to discountenance the idea of these secretions being mere albuminates of potass or soda.

14. Fresh serum of human blood, freed, as in the last experiment, from its fat, by agitation with ether, was treated with a solution of pure ammonia, the action being aided by the application of a gentle heat. The nearly-neutral albuminate of ammonia thus obtained still more closely resembled mucus than the combination with soda, on account of the peculiar pale greenish tint it possessed, and in its becoming opaque and turbid by protracted ebullition; which change was accompanied by a disengagement of ammonia; and therefore could not be regarded as identical with that produced in mucus, as in the latter case it is accompanied by an evolution of carbonic acid gas (7). The re-action of acetic acid served still further to shew its entire difference from genuine mucus, otherwise than in appearance.

15. Some very dilute albuminate of soda was mixed with a solution of the mixed chlorides of sodium and ammonium, salts well known to exist in mucus: a current of carbonic acid gas was passed through the fluid for two hours. The first effect of this acid was, to induce a precipitation of finely-divided albumen, which subsequently re-dissolved in the aqueous solution of carbonic acid. The solution, after being filtered, to free it from a small quantity of undissolved albumen, was colourless, very slightly opalescent, easily frothing by agitation, and became opaque by protracted ebullition, and by exposure to the air or an atmosphere of hydrogen; *these changes being accompanied by an evolution of carbonic acid gas.*

Here, then, it is evident that we have obtained a fluid very closely resembling mucus, in some of its most characteristic properties; but still differing, in yielding an amorphous albuminous precipitate with hydrochloric acid, and in its limpidity not being disturbed by acetic acid. Mixtures of alkaline albuminates, with solutions of albumen in carbonic acid in different proportions, were then tried, but with no better success: the peculiar effect of acetic acid on true mucus could never be imitated, the deposit produced being invariably amorphous and granular. The alkaline acetates, which are stated by Gmelin to dissolve coagulated albumen, were repeatedly tried, but without any satisfactory results being arrived at. These salts, resembling closely the lactates present in mucus, were found to dissolve but minute portions of albumen; and the solutions obtained behaved with reagents like a solution of albuminate of soda (13).

16. We have next to consider Dr. Babington's interesting experiments on the apparent synthesis of mucus from pus. I have already mentioned the resemblance of the latter secretion to blood deprived of its colouring matter, and that physical structure, or molecular arrangement, necessary for the development of spontaneous coagulation. This resemblance nearly approaches absolute identity, if we admit fibrin and insoluble albumen to be but slight modifications of one and the same organic substance. In operating upon pus, therefore, we may consider, that instead of simple serum, or the aqueous solution of albumen, used in the preceding experiments, we are using serum through which particles of albumen, in a state of minute division, and containing iron, are diffused. When, to some pus contained in a cylindrical vessel, a small quantity of a solution of potass, soda or ammonia is added, the phænomena described by Dr. Babington occur;—the pus soon loses its fluidity, the particles of albumen contained in diffusion rapidly disappear, and a viscid, nearly translucent, sometimes semi-solid mass results: if this is mixed with distilled water, and violently agitated for some minutes, the transformed pus becomes so minutely and intimately diffused through the fluid, that the mixture is capable of passing through a coarse paper filter: it then appears as a viscid

ropy fluid, readily entangling bubbles of air, and frothing on agitation, possessing a slight alkaline re-action, and behaving to most re-agents in a manner analogous to mucus, (3), excepting in the action of hydrochloric and acetic acids, both of which produce an *amorphous* deposit of albumen: it differs, also, in not becoming opaque by protracted ebullition, nor by exposure to an atmosphere of hydrogen gas; although, when left in an open vessel, exposed to the air, it lets fall, very slowly, a deposit of albumen; this change being accompanied by an *absorption* of carbonic acid, whereas in the case of true mucus this deposition is accompanied by an *evolution* of that gaseous acid. Notwithstanding these discrepancies, it is evident that we have approached much nearer towards a synthesis of mucus than could prior to Dr. Babington's observations have been effected; although the only material difference in the mode of experimenting depended upon the substitution of a mixture of albumen in solution with that principle in an insoluble but minutely divided state (pus?) for an aqueous solution of albumen (serum) only.

17. The next fact mentioned by Dr. Babington, is the remarkable action of neutral salts on pus. This may be observed by mixing a solution of common salt (chloride of sodium) with pus, in a tube, and agitating the mixture for some minutes: it should then be set aside, and, after some time, instead of the opaque, cream-like, and very fluid mixture that was submitted to experiment, we shall obtain a nearly diaphanous, exceedingly viscid, mucoid mass. This substance is quite insoluble in water; and should be repeatedly washed with that fluid, until any excess of saline matter is removed: it then most accurately resembles mucus, in its behaviour towards most re-agents: even acetic acid yields with it the peculiar membrane-like, corrugated mass which has been so frequently referred to in this paper, as characteristic of the animal matter of mucus. Still, the analogy is far from being complete; for this artificial mucus does not become opaque by long-continued ebullition, nor by exposure to the air or an atmosphere of hydrogen: it is also, as might be expected, destitute of any alkaline re-action on vegetable colours; but could these characters be communicated to it, it is evident that the resem-

blance to genuine mucus or saliva would be most perfect: and this desideratum was effected in the following manner.

Some healthy pus was mixed with solutions of common salt and sal-ammoniac (chlorides of sodium and ammonium) in equal bulks, and agitated for some minutes: after half-an-hour's repose, the mucoid mass before mentioned was obtained: this was digested with pure water, until the excess of saline matter was removed. The gelatinous mass thus obtained was nearly tasteless; and was found, by analysis, to contain in combination both the alkaline chlorides, added to the original pus: it was then diluted with about fourteen times its bulk of distilled water, containing in solution a small quantity of pure soda; the whole was violently agitated for nearly twenty minutes; and a current of carbonic acid gas transmitted, until no more appeared to be taken up. The fluid thus obtained passed very slowly through a paper filter: it exerted a faint alkaline action on reddened litmus-paper; was sufficiently tenacious to be drawn into threads between the fingers; and even to form a continuous *rope* some inches in length, on pouring it from one vessel to another. By agitation, it frothed readily: with acetic acid it yielded the characteristic membrane-like precipitate of mucus; and behaved, with every re-agent with which it was tried, like a genuine mucous fluid. By protracted ebullition, exposure to the air or to hydrogen, it afforded a deposit of albumen; this deposition being accompanied by an evolution of carbonic acid gas. Indeed, so accurate was the resemblance of this artificial mixture to true mucus or saliva, both in its physical and chemical characters, that it was quite impracticable to distinguish the one from the other.

18. An interesting question now arises, as to what part the saline substances, mixed with pus, act, in effecting its conversion into a mucoid matter. Do they actually enter into combination with the particles of albumen, and form a definite compound? or do they act solely by the exertion of a catalytic force, and thus effect changes in the composition of the organic matter present, by the influence of predisposing affinity, or " action of presence," as it has been termed? The latter hypothesis appeared, at first, to be most probable; but subsequent investigations have shewn it to be quite untenable: for

as it is essential to catalytic action* that the substance pro-
ducing it should not *combine* with the new-formed substance,
but should admit of being readily removed without affecting
the composition or properties of the latter; so, if it can be
proved that the saline substances used in the above experi-
ments actually form an intimate and perhaps definite com-
bination with the albuminous particles, it is obvious that the
existence of catalysis cannot be considered as either essential
or necessary for the conversion of pus into mucus.   There is
no difficulty whatever in demonstrating the latter opinion:
for if the gelatinous mass obtained by digesting pus with
common salt, or an alkali, is washed repeatedly with hot or
cold water, we shall not succeed in separating from them any
thing like the whole of the saline ingredients that may have
been absorbed by, or combined with, the artificial mucus;
nor can these saline matters be separated entirely, except by
destroying the organic matter present by means of strong
acids or a red heat.   Indeed, the analogy between our facti-
tious and natural mucus would not be complete without this
peculiarity; for if we evaporate pus and mucus, over water-
baths, to dryness, and incinerate equal weights of the dry ex-
tracts, it will be found that the quantity of saline matter
present in the ashes will be far greater in mucus than in
pus: and not only is this constantly the case, *but the amount
of saline matter obtained by incineration, from different speci-
mens of mucus, will be found to diminish nearly in the ratio of
its opacity, or, in other words, of its approach to the puriform
state.*   I am happy that, on this important subject, I am not
obliged to depend entirely on my own experiments; as
my friend, Mr. R. H. Brett, in a very elaborate paper on
Expectorated Matter, read before the British Association at

* For an account of this catalytic force, I must beg to refer to Berzelius'
account, in the "Annuare" for 1837.   Mitscherlich, under the head of Oxyge-
nated Water, gives a brief, but very accurate, view of this action of contact:—
wie an der oberfläche von verschiedenenen Substanzen chemische Verbindungen
und chemische Zersetzungen hervorgebracht werden, ohne dass diese Substan-
zen selbst dadurch verändert werden. *Da die Substanzen nur durch ihre Ober-
fläche wirken,* so ist bei derselben Menge ihre wirkung um so grösser, je fein-
vertheilter und je reiner sie sind.   Solche Substanzen nennt man Contactsub-
stanzen, und den Process selbst: chemische Verbindung oder Zersetzung ver-
mittelst Contact.—*Mitscherlich : Lehrbuch,* 1ste Band, s. 37. Dritte Auflage.

Liverpool, in September last, stated the results of his own researches on this point, to the examination of which he had devoted considerable time. As his paper is not yet published, I requested him to favour me with a summary of the results he obtained from the evaporation and incineration of mucus in various states. The following is an extract from his Letter to me on this subject.

" In accordance with a wish expressed by you, that I would
" give you some account of the amount of solid and saline
" matters obtained from different forms of expectorated mat-
" ter, I send you the following: and need hardly inform you,
" that it forms part of my Observations on Expectorated
" Fluids, read before the British Association in September last.
" I shall detail the amount of solid and saline matter, in the
" different varieties of sputa, in the same order as I described
" them in the paper before alluded to. In the pituitous ca-
" tarrh of Laennec, the quantity of solid matter obtained from
" 100 gr. of the fluid expectorated, varied from 1.2 gr. to
" 1.4 gr.: the amount of saline matter in 100 gr. of the dried
" extract varied from 20 gr. to 33.3 gr. The expectoration
" in question was nearly transparent, exceedingly viscid,
" abundant, and very frothy. In expectoration of the chronic
" bronchitic variety, the quantity of solid matter varied from
" 2.2 to 4.1 per cent. The saline ingredients varied from
" 16.6 to 23.3 per cent. of the dried extract. The expectora-
" tion was lumpy, of a greenish or yellowish green hue,
" aërated, and viscid. The expectoration in pneumonia, with-
" out any bronchial complication, yielded 8.6 per cent. of dried
" extract, of which the saline ingredients averaged 12.5 per
" cent. The amount of solid and saline matter which follows
" is from pthisical expectoration in the last stages; for in the
" earlier and middle stages of the disease it differs not from
" that of chronic bronchitis. The expectorated fluid yielded a
" dry extract, varying from 11.3 to 16.66 per cent. The saline
" matters varied from 9.8 to 11.3 per cent. of the dried extract.
" I may observe, that the expectoration operated upon
" was of the most marked pthisical character; in some in-
" stances so puriform, as to resemble pretty closely a col-
" lection of ordinary pus."

The results detailed in the above communication will become more striking, if compared together.

Variety of Mucus.	Quantity of Dry Extract in 100 grains.	Quantity of Saline Matter in 100 gr. of Extract.
—	—	—
Nearly pure mucus (acute catarrh)	1.20 to 1.40.	20.0 to 33.3.
Very opaque and viscid mucus (chronic bronchitis)	2.20 to 4.10.	16.6 to 23.3.
Puriform (last stages of phthisis)	11.30 to 16.66.	9.8 to 11.3.

These remarks will be sufficient, I trust, to shew, that for pus to become mucus, it is absolutely necessary for it to absorb or combine with saline matter in very considerable quantity.

19. In this stage of our inquiry, it becomes an interesting question, to discover whether artificial mixtures of soluble and insoluble albumen could not be converted into mucus, by means of saline matter, as readily as pus. Very numerous experiments, varied in almost every possible manner, were tried; but the results were not so satisfactory as could be wished: nor is this to be wondered at, when we call to mind the difficulty of obtaining insoluble albumen in a state of such exceedingly minute division as that in which it exists diffused through serum in pus. The nearest approximation to a satisfactory result was obtained in the following manner :—

Some serum of human blood was digested with pure soda, until it ceased to become opaque, on the application of heat : through this fluid, a current of carbonic acid gas was passed, until a copious deposit of albumen occurred: the current of gas was then interrupted; and the precipitate well washed, and drained on a filter. The finely-divided albumen thus procured was mixed with recent serum of blood, in sufficient quantity to form a mixture resembling, in appearance, healthy pus; from which it did not differ in chemical composition, excepting in the absence of iron, which is always, as has been already mentioned, present in true purulent matter. On mingling a solution of potass or soda with this artificial pus,

in the manner described by Dr. Babington, analogous changes occurred, but in a much less complete and perfect manner than with genuine pus.

The viscid flocculent form of mucus lining the intestinal canal, as well as the variety occasionally thrown off and discharged from the bowels in certain cases of severe intestinal irritation—as in fever, and after the action of drastic cathartics—is almost identical with coagulated albumen, scarcely any other substance appearing to enter into its composition. This close resemblance between intestinal mucus and mere coagulated albumen has been fully demonstrated by Leopold Gmelin; who, after detailing the action of re-agents on this form of mucus, observes :—D'après ces expériences, le mucus intestinal a beaucoup d'analogie avec l'albumine coagulée : seulement sa solubilité est moins grande. Peut-être n'en est-il qu'une modification.—*Tiedemann et Gmelin, Recherches sur la Digestion,* Partie Première, p. 103, &c.

C.—*Chemical and physiological deductions from the foregoing observations.*

If the facts advanced in the two preceding sections are proved, by subsequent observers, to be universally correct, we cannot but admit their importance, even if they only serve to point out the analogy between mucous and serous surfaces, as evinced in their secretions. And if, as has been shewn, *albumen* can readily, under certain circumstances, become converted into mucus, so we no longer have any difficulty in understanding how mucous membranous surfaces may, under certain states of irritation, pour out albumen in a free or coagulated state. Thus, if the lining membrane of the larynx and trachea—which presents, normally, a surface secreting genuine mucus—be considered as pouring out the albuminous particles of the blood combined with an excess of saline matter (thus constituting mucus ?), we have no difficulty in understanding how the same membrane may, from incidental circumstances, pour out the albuminous particles of blood combined with but a small proportion of saline matter, constituting that form of secretion to which the term "lymph" is applied—a secretion capable of taking on organization, in which particular it physiologically and essentially

differs from mucus.   If this hypothesis be admitted, as fairly
deducible from the preceding observations (17 et seq.), we must
consider (for example) the secretion of the larynx and trachea,
when in a state of health, as chemically differing from that
poured out under the irritation of croupy inflammation, only
in the different proportions of saline ingredients present in
each ; and, consequently, we are not compelled to assume, in
explanation of the difference of secretion, that in croup a
mucous surface assumes the functions of a serous surface
(*quoad* secretion).

But it may be objected to those deductions which depend
upon the supposed synthesis (17) of mucus, that, according to
the experiments of Dr. Babington and myself, it must be
assumed that pus is *first* formed, and then carried to the
secreting surface, as a pabulum for the formation of mucus ;
thus making the latter a secondary product.   This objection,
however, can scarcely be considered as tenable; for pus has
only been used, in our experiments, for the synthesis of
mucus, because it presents us with particles of albumen in a
state of far finer division than can be procured by artificial
means.   It is, moreover, sufficiently obvious, that, in the
animal economy, pus is not really converted into mucus; for
the former contains a large quantity of iron, which metal is
nearly or altogether wanting in mucus.   Is there (I would
with great diffidence ask) any physiological difficulty in sup-
posing that on the surface of a serous membrane the blood
gives up a mere aqueous solution of albumen with its ac-
companying saline matter (serum) ; whereas on a mucous
surface it parts with a mixture of its colourless albuminous
particles (which have been long known to exist in blood) with
serum ; whilst at the instant of their separation, or, to use
chemical language, whilst in a nascent state, both combine,
with an excess of saline matter; thus constituting, according
to the observations recorded in this paper, mucus, which
becomes poured out on the secreting surface ?   On a suppu-
rating surface, on the contrary, may we not also suppose that
the blood parts with all its ingredients, excepting its colouring
matter, and that portion of dissolved albumen * which pos-

* " Faserstoff aufgelöste " of Müller.   To this eminent physiologist we are
indebted for the demonstration of this modification of *albumen*.   It appears to
be

sesses the property of spontaneous coagulation; thus forming pus?—These views, even if their correctness be denied in a physiological point of view, are nevertheless strictly in accordance with the chemical properties and composition of blood, serum, pus, and mucus. These remarks, however, I hazard with extreme diffidence; rather wishing to place before the scientific world an account of this experimental inquiry, than to present any crude and imperfect deductions of my own; trusting, also, that the observations recorded in this paper will attract the notice of those more fitted to the task of investigating their physiological bearings than myself.

be chemically identical with that which in a coagulated state constitutes the colourless globules (Chyluskügelchen) of the blood, as well as the centre of the blood-corpuscules (Blutkörperchen). For an account of the chemical pro- perties of these varieties of albumen, I may take the liberty of referring to Müller's own account. Handbuch der Physiologie des Menschens, 3tte Auflage, 1ste Band, pages 103, 113, 116, and to page 135, for an exceedingly interest- ing account of the chemical relations of an aqueous solution of spontaneously coagulable albumen (*Faserstoff*, Fibrin), as compared with those of a solution of that substance when destitute of that remarkable property (*Eiweiss*, Albumen).

ACTION OF WATER ON LEAD,

IN RELATION TO

MEDICAL POLICE.

BY ALFRED S. TAYLOR.

AMONG the uses to which the metal lead is applied, the con-
struction of cisterns and pipes, for *holding or transmitting
water*, is perhaps one of the most important. From its cheap-
ness, flexibility, and durability, this metal has long taken
precedence of all others for the purposes mentioned; and its
employment in this country is now nearly universal. Inde-
pendently of its uses for the construction of cisterns and pipes,
we find it also largely employed in the roofing of buildings.
The rain water which falls upon these leaden roofs is col-
lected, and, when spring water is not easily obtained, is
made to serve as a substitute. From the very serious effects
which have occasionally followed the use of water thus
brought into contact with lead, some physicians have wholly
condemned the employment of this metal for domestic
purposes, and have recommended that it should be laid aside.
Remer, a distinguished German writer on Medical Police,
alludes, with an expression of surprise, to the general custom,
in this metropolis, of employing leaden pipes for supplying
the houses with water : and it appears that Scheele was so
impressed with the danger of the practice, that he advised,
wherever lead was used, that the surface of the metal should
be covered with some varnish, insoluble in water, and capable
thereby of preventing it from becoming impregnated with
lead. Those who have written on the subject of colica picto-
num have not failed to draw the attention of the profession
to the poisonous properties acquired by water when it has
been allowed to pass over surfaces of lead, or to remain for a
time in leaden cisterns. The lead colic, which prevailed

at Amsterdam about the middle of the last century, was apparently, with good reason, ascribed to the substitution of lead for tiles in roofing the houses of that city. Rain water, owing to the want of spring water in that part of Holland, was employed for domestic purposes; and, doubtless, to this cause were to be ascribed the ravages committed by the sudden irruption of the colic, in an epidemic form. Other instances of the mischief resulting from the use of water, under these circumstances, might be mentioned; but, for an account of these, I must beg to refer the reader to the numerous treatises which have been published on the colica pictonum. It may suffice to say, that in general the mischievous consequences have been observed to ensue when rain water was employed, or hard water, either containing much less than its ordinary proportion of saline matter, or abounding in carbonic acid.

Considerable difference of opinion has existed among observers of these facts, relative to the manner in which water acquires a poisonous impregnation, when exposed in contact with lead. In the Amsterdam epidemic, Tronchin referred the production of the poisonous salts of lead to the decomposition of vegetable matter, collected on the roofs of houses, and the consequent generation of acids, which acted on the metal, and led to its solution in water. Dr. Lambe, who was one of the first Englishmen to pay attention to this subject, considered that the salts contained in spring water exerted a corrosive action on lead: that, therefore, all waters abounding in saline matter have the power of corroding lead; a proposition, which, as we shall see presently, from the researches of Dr. Christison, of Edinburgh, is exactly the reverse of the truth. Dr. Thompson, who adapted Dr. Lambe's view, that most spring waters had the power of acting on lead, restricted his inference as to the consequences, by asserting that the quantity of lead dissolved was in general too small to have any injurious effects upon those who made use of it for domestic purposes. He also considered that the lead was not dissolved, but simply suspended, in the water. On analysing, some years since, the Tunbridge water, which was then conveyed through leaden pipes, he found that it did not

contain more than $\frac{1}{800000}$th part of lead; a quantity insuf-
ficient to produce any serious disturbance of health. Dr.
Thompson does not appear, however, to have extended his
researches to the cause of the impregnation of water by lead,
or to the state in which that metal is taken up. Guyton-
Morveau was one of the first to experiment on this subject;
and he came to the conclusion, that lead, when exposed in
contact with water, becomes oxidized; and that the hydrated
oxide of the metal is soluble in pure water, but insoluble in
water containing the least traces of saline matter. He found,
that if distilled water was allowed to remain for some time in a
leaden vessel, the lead was attacked, and the water acquired
a feeble alkaline re-action. The presence of lead was proved
in it by the action of sulphuretted hydrogen gas and sulphuric
acid. Spring water, on the contrary, containing saline matter,
exerted no solvent power on the lead*. The observations of
Guyton-Morveau, relative to the different action of distilled
and hard water on lead, are correct: but his statement of
the changes which take place has not been borne out by sub-
sequent researches. In a work published by M. Mérat, in
1812, it was announced that he, in conjunction with M. Bar-
ruel, had obtained two ounces of crystallized carbonate of lead
by the evaporation of a large quantity of water, which had
been kept about two months in a cistern lined with lead†.
Thenceforward, there could be but little doubt as to the
actual state in which the lead existed when suspended or dis-
solved in water; or, if any doubt remained, it would have been
wholly removed by the admirable researches of Dr. Christison.
This gentleman found that pure water, exposed to air, acted
with the greatest rapidity on lead;—that the chemical change
consisted, on these occasions, in the simple formation of a
carbonate, which was partly deposited on the lead, but chiefly
at the bottom of the vessel;—that a minute portion of this
carbonate was also, under these circumstances, dissolved;—
that natural waters, containing saline matter, had little or no
action on lead;—and that, if any carbonate were formed and
dissolved, it was only in the most minute proportion, and

* Berzelius, Traité de Chimie, III. 178.
† Orfila, Traité des Poisons, I. 619.

after the lapse of a considerable interval. He discovered, further, that if certain neutral salts were dissolved in distilled water, they retarded or prevented its corrosive action on lead, allowing the carbonate to deposit itself slowly, and adhere with such firmness to the metal as not to be afterwards removable by moderate agitation; adding, subsequently, to this crust, other insoluble salts of lead, the acids of which are derived from the neutral salts in solution; and thus, at length, forming a permanent and impermeable screen, through which the action of the water cannot any longer be carried on*.

During the last seven years, I have, at different intervals, performed experiments on this subject. The results of some of these are here collected and arranged. My views were chiefly directed to the following points:—1. To ascertain the changes which take place when lead is exposed, under the free access of air, to the contact of pure water, of natural hard water, and of water rendered artificially hard by the addition of saline matter. 2. To determine the best means for preventing water from acquiring a poisonous impregnation by lead, where it is of such a nature as to exert this corrosive action on the metal.

When lead is exposed to dry air, it very slowly acquires a greyish-blue coating, by which it is deprived of its usual lustre. According to some, this tarnishing is owing to the formation of a suboxide of the metal; but others look upon it as a result of the production of a thin pellicle of carbonate of lead. The latter view, perhaps, is the more probable; at least, it is certain that this is the kind of chemical change which takes place when there is the slightest humidity present in the air. Both the oxygen and carbonic acid are derived from the atmosphere, although the presence of water singularly favours the chemical change. If the lead be long exposed in a damp situation, it gradually becomes covered with dense patches of carbonate, which adhere with some firmness to the metal below, and preserve it in these spots from the further action of the air.

Let us next consider the effect of pure water on the metal.

* Treatise on Poisons, 390.

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Dr. Christison has already made it known, that pure water, deprived of air, possesses no action whatever on lead. The following experiments confirm his views:—

Exp. 1.—A piece of lead was placed in a vessel of recently-distilled water, which had been boiled to expel air, and the vessel kept in vacuo for a period of three days. At the end of this time, the lead had undergone no change; the water was perfectly clear, and free from any precipitate; while, in another vessel similarly prepared, but which had remained exposed to air, the lead, especially at its upper part and edges, had acquired a crystalline incrustation of carbonate; and loose portions of that salt were floating in the water, so as to render it turbid on agitation.

Exp. 2.—Another portion of lead was placed in a small bottle, filled with distilled water, and the bottle perfectly closed, so as to cut off the access of air. On examination, fifty-six days afterwards, the lead had undergone no change; its surface was not in the least tarnished; and the water was perfectly clear.

Exp. 3.—The last experiment was modified, by placing a stratum of oil, about an inch thick, on the surface of the water, in which a piece of lead was immersed. In this case, the lead became slightly tarnished, and a small quantity of carbonate of lead was formed. The examination was made thirty-two days after the commencement of the experiment.

The results of the two first experiments shew, that, provided the free access of air be cut off, pure water has no tendency to act upon lead. In the last experiment, the formation of a portion of carbonate was probably due to the entrance of air not having been effectually prevented by the stratum of oil.

The action of water on lead freely exposed to air varies according to certain circumstances; the principal of which, however, is the *absolute purity* of the water itself. Thus, the purer the water, the more rapidly does the chemical action take place. The other circumstances which modify the rapidity of change are the following:—1. The brightness of the lead. If lead, which has become very dull from exposure to

air, be introduced into distilled water, the change takes place but slowly. After a very long period, but little carbonate is formed; and this chiefly from the recently-cut or bright edges of the slip of metal introduced. 2. The change takes place more rapidly when the piece of lead is only partially immersed in water. This, perhaps, is to be ascribed to the circumstance, that the carbonate is most abundantly formed about that portion of the lead which is at the level of the water; but, whether this be the correct explanation or not, the total immersion of the piece of metal appears to retard the chemical change. 3. It has seemed to me, from several observations, that the change, *cæteris paribus*, takes place more rapidly during summer than during winter. I have more than once remarked, that as much carbonate formed in the course of a few hours in the month of June as resulted from upwards of three days' exposure, under similar circumstances, in the month of December.

The kind of water employed is, however, the chief point to attend to in this investigation. Accordingly, the following experiments were made:—1. On *distilled* water; 2. On recently-fallen *rain* water, collected in the open air; 3. On hard, or *river* water.

Exp. 4. A slip of lead, having a bright surface, was allowed to remain in recently-distilled water for a period of twenty-three days. Chemical action took place but slowly. In less than a week, there was a dense, white, crystalline precipitate at the bottom of the vessel, as well as partially distributed over the surface of the lead. The water was filtered, and evaporated to one-fifth of its bulk. When sulphuretted hydrogen gas was passed into the filtered liquid, it acquired a brownish colour, indicating the presence of a small proportion of a salt of lead. The precipitate left on the filter, when examined, had all the characters of carbonate of lead. It entirely dissolved, with effervescence, in acetic acid; and when another portion was heated on platina-foil, it left a residue of protoxide of lead.

Exp. 5.—A piece of lead was allowed to remain partially immersed in distilled water for a period of forty-four days. In the course of twenty-four hours the surface of the metal

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had become covered with a white crystalline incrustation, easily removed by agitation. The water was perfectly milky. The crystalline deposit appeared to go on increasing for about three weeks; but after that time, and until the period of examination, there was no perceptible increase, notwithstanding that the vessel was occasionally agitated. On the forty-fourth day, the water was filtered, and a pearly crystalline precipitate of carbonate of lead was obtained, weighing 4.54 gr., equivalent to 3.79 gr. of metallic lead. The metal, when washed and examined, presented only two small spots of corrosion. The filtered liquid was colourless, tasteless, and neutral: it acquired a slight brown discolouration when sulphuretted hydrogen was passed into it, indicating the presence of lead. The precipitate was found to be pure carbonate of lead.

Exp. 6.—In this case, the piece of lead was weighed before immersion: its weight was 232 gr. After immersion in distilled water, a white crystalline deposit rapidly formed around it, which adhered so loosely, that the slightest motion detached it. It was allowed thus to remain 106 days, the loss by evaporation being made up. At the end of that time it was examined. The lead was found to have lost four grains, and an equivalent quantity of carbonate had been formed. The water, after filtration, gave faint traces of the presence of lead. The precipitate was entirely formed of carbonate.

Exp. 7.—In this experiment, larger proportions of lead and distilled water were used. The formation of carbonate began with great rapidity, soon after the immersion of the metal; and at the termination of the experiment—*i. e.* after the lapse of 242 days—a very considerable quantity of carbonate was deposited in crystals at the bottom of the vessel, as well as on the lead. The unfiltered liquid was feebly alkaline where any carbonate lodged on the test-paper. When filtered, and submitted to the action of sulphuretted hydrogen, it gave very evident traces of the presence of lead*.

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* This action of distilled water on lead is so striking, that I have frequently made use of it as a test to determine the purity of distilled water. The presence of the smallest fractional quantity of acid or saline matter will prevent the ready formation of carbonate of lead. Even where nitrate of barytes and nitrate of silver have produced but the faintest cloud on being added to dis-
tilled

Among natural waters, rain water approaches the nearest, in its properties, to distilled water. Many years since, Dr. Lambe stated, that rain water had not the power of corroding lead; at least, he thought that its effect on the metal was so slight, as not to be perceptible within any moderate period of time. Guyton-Morveau's experiments shewed that this conclusion was erroneous; and Dr. Christison's more recent observations have left no doubt that pure rain water, as well as that derived from the melting of recently-fallen snow, has the same kind of action on lead that distilled water has;—a result for which we might have been prepared. Dr. Christison, however, found that rain water, collected recently after a shower in a large city, was so contaminated by foreign ingredients, as to exert no action on lead. But when the water was collected after a continued rain of some hours, or in the open country, at a distance from Edinburgh, it affected the metal with the same rapidity as distilled water. In several analyses which I have at different times made of rain water, as it has fallen in London, I have found it to contain traces of sulphuric and muriatic acids; and this, even where it has not been collected from the roofs of houses, but in vessels placed in the open air, at a distance from buildings. The impurities are, doubtless, derived from the smoky atmosphere of this metropolis.

Exp. 8.—Some rain water was collected, as it directly fell through the atmosphere of London, after a very heavy shower of some hours' duration. It contained traces of sulphuric and muriatic acids, but no lime. A piece of lead was plunged into it, and allowed to remain partially immersed forty-two days, the vessel being exposed to the air. At the end of this period, the lead had become somewhat tarnished. A very small quantity of carbonate had been formed, which partly adhered to the edges of the metal, and was partly precipitated to the bottom of the vessel. A portion of the liquid was filtered, and sulphuretted hydrogen gas passed into it;

tilled water, its impurity has been sufficiently demonstrated by its resisting, for many days, and even weeks, the formation of carbonate of lead. In employing this test to determine the purity of water, care must be taken that the vessel be quite clean, and that the surface of the lead be recently scraped before immersion, so as to present its greatest lustre.

but there was no effect. On passing the gas into a portion of the unfiltered liquid, it was turned faintly brown, owing to the presence of carbonate of lead, mechanically diffused through it.

In this case, the formation of carbonate was probably interfered with by the presence of impurities in the water. Still, it shews that a poisonous salt is liable to be formed by the contact even of the impure rain water of London with lead; and, *à fortiori*, the formation of this salt would be more certain and more abundant where rain water was allowed to collect and remain exposed in vessels of lead, in the open country.

From the preceding remarks, we find that water exposed in contact with lead to the air induces the formation of carbonate of lead with a rapidity proportioned to its purity, and in a degree commensurate with the length of exposure and the surface of metal exposed. Without the presence of water, either as a liquid or vapour, the metal has no tendency to pass to the state of carbonate; and where it is present, the water itself undergoes no decomposition, but seems merely to serve as a medium of transference of the oxygen and carbonic acid of the atmosphere to the metal. The gases are probably dissolved by the water, and thus brought into a favourable state for chemical combination. As each particle of oxygen unites with the metal, the carbonic acid seizes the oxide formed, and converts it to carbonate. The formation of the salt, although described as rapid in pure water, is sufficiently slow to allow the carbonate to assume a crystalline form; since it is almost always met with in pearly scales, either fixed to the lead, or diffused through the liquid. The carbonate deposited on the surface of the metal, above the level of the water, is, however, generally in the state of a white powder. It would not, perhaps, be difficult to explain, on the common laws of affinity, why the water should thus continually absorb fresh portions of oxygen and carbonic acid, to convert the lead to a carbonate. We know that pure water has a great tendency to absorb these gases; and if it contain any body, such as lead, capable of combining with them as they are absorbed, other portions will of course be taken from the atmosphere, until,

from the destruction of the lead, or the entire covering of the
metal by a crust of carbonate, the action ceases. The effect
of water, in this case, appears to approximate to that power
among bodies which has lately been denominated, by Berze-
lius, *catalysis.*

The poisonous properties of the carbonate of lead are
known and admitted by all. Some toxicologists contend, that
it is the only poisonous salt of the metal; but there is consi-
derable doubt whether this view be correct. It is also well
ascertained, from the history of the manufacture of white
lead, that those engaged in the employment are liable to
suffer severely in health, or even to die after a certain pe-
riod, unless rigorous precautions be adopted. Now, in these
cases, the poison is received in the most insidious manner.
Among the ways of its becoming introduced into the body,
respiration is, perhaps, the most general: and it is thus that
we can account for the destruction of horses, rats, and other
animals, about white-lead manufactories *. The grinding of
the substance in water has, however, considerably diminished
these serious consequences. My object, by these remarks, is
to shew, that very minute doses of this poison may be un-
consciously taken into the system; that they will there, per-
haps, lie dormant for some time; but, sooner or later, their
effects may be manifested by a severe attack of colica pic-
tonum, or other alarming symptoms affecting the nervous
system. The question now presents itself, whether such
effects might not follow from the long-continued use of rain
water as an article of diet, where it had been collected or
preserved in leaden vessels? The answer appears to me to
be undoubtedly in the affirmative; and, for proofs of the fact,
I would refer to the treatises on colic already alluded to.
The danger does not seem to arise so much from the quan-
tity of carbonate actually dissolved in the water, as from that
portion of the salt which is mechanically diffused through it.
The carbonate of lead is generally set down as insoluble; but
this term has only a relative signification. Dr. Christison
found it to be soluble in his experiments; and I gather from
one of these, that water will take up about $\frac{1}{57000}$th part of its

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* I here allude more particularly to those of France.

weight of the carbonate. Perhaps, when actually formed within the water, its solubility is greater than where its particles have been allowed to become aggregated. In the experiments already related of the action of distilled water on lead, the carefully-filtered liquid was always turned faintly brown by sulphuretted hydrogen gas; which test, I may remark, will detect, according to Dumesnil and Devergie, a salt of lead, when it does not form more than $\frac{1}{500000}$th part of the weight of a solution*. In the experiment with rain water, the filtered liquid gave no trace of lead; but the rain water, as we have seen, contained impurity, and the quantity of carbonate formed was inconsiderable. Under all the circumstances, however, the chief danger of using such water will, I think, be due to the quantity of carbonate mechanically diffused through it. This easily mixes with the water by the slightest agitation, or may even be rendered completely soluble by any acids present in culinary vessels, where water of this description is employed for domestic purposes. Here the most serious consequences may ensue. All other circumstances being equal, a new leaden roof, cistern, or new leaden pipes, will give rise to a rapid and abundant formation of the carbonate. After a time, the surface of the metal becomes covered with a thin adhering crust, which, unless it be detached by the force of falling rain, or other mechanical

* I consider it necessary here to state, that I have not always succeeded in detecting lead in distilled water, filtered after sufficient contact with the metal to produce carbonate of lead. These were cases, however, in which but little carbonate had formed; and the experiments were altogether on a very small scale. It would be well, on such occasions, to evaporate the filtered water to a much smaller bulk, before passing in the gas. In the unfiltered water, lead, in greater or less abundance, may always be detected. It is essential to bear in mind, in filtering water under these circumstances, that, if there be much carbonate of lead present, and the vessel be shaken, filtration will not effectually separate the salt. The carbonate of lead, like the sulphates of lead, and barytes and oxalate of lime, will, in a very finely-divided state, actually traverse filtering paper, although not dissolved in water. Hence, sometimes, an experimentalist will find that sulphuretted hydrogen will cause a much greater effect than at others;—a result which he must not attribute to a greater proportion of carbonate of lead being dissolved. In a practical point of view, that water is the most to be dreaded which, even after filtration, is affected by sulphuretted hydrogen, whether this be due to the *solution* of the salt in water, or to its *mechanical suspension* in that liquid, in a state so finely divided, as to allow it to pass through the pores of paper.

causes, will, for a certain period, prevent the production of the poisonous salt. Thus, water collected from an old leaden roof is not so liable to be impregnated with the carbonate as that formed of new metal; but even in that case, a hard shower of rain might detach the crust from the old lead, and again expose the metallic surface. By a reference to these circumstances, we may, perhaps, explain why symptoms of lead-poisoning have ceased in a family, and, after a certain interval, have again made their appearance.

The means by which the formation of the carbonate may be retarded or prevented in the contact of pure or rain water with lead will presently be adverted to.

We have now to speak of the action of natural *hard water* on lead; by which I shall understand *spring* and *river* water. The experiments were made on *river* water, which generally contains less saline matter than spring water; but, provided the latter be supposed free from carbonic acid, or containing but a small proportion of that gas, the following observations will equally refer to it. It is singular that, formerly, hard water alone was considered to exert a corrosive action on lead, by reason of the saline matter which it contains, when the exact reverse of this assumption is the truth. The hard water employed in these experiments was the Thames water, filtered, and freed from the greater part of its mechanical impurities, by rest. Its specific gravity does not differ greatly from that of distilled water; and I found that 7680 gr. of it, evaporated to dryness, left a brownish-coloured residue, which weighed 2.3 gr., one-half of which was insoluble silicious matter. By this we may estimate that the water contained nearly $\frac{1}{7000}$th of its weight of soluble saline matter. On analysis, the chief ingredients were found to be sulphuric and muriatic acids, with lime and magnesia, of which the sulphuric acid and lime predominated.

Exp. 9.—A slip of bright lead was introduced into a portion of this water, and allowed to remain exposed to the air for thirty-two days. The lead was unaltered in appearance; the water was perfectly clear; and, on filtration, no residue was left on the filter. Neither the filtered nor the unfiltered water became in the least degree discoloured when sulphu-

retted hydrogen was passed into it; shewing, that no carbonate of lead had been formed. Although that portion of lead immersed in the water was as bright as when first placed in the vessel, yet, at a little distance above the level of the water, the surface of the metal presented a slight white patch, somewhat firmly adhering to it; which turned out, on examination, to be carbonate of lead. The cause of the formation of this will be alluded to presently.

Exp. 10.—The lead was allowed to remain forty-four days in the hard water. Its surface was but in the slightest degree tarnished; this being due to a small quantity of dust derived from the atmosphere during exposure. No portion of carbonate of lead had been formed; and the filtered and unfiltered water was unaffected by sulphuretted hydrogen gas.

Exp. 11.—A slip of lead, weighing 439 grains, was introduced into the water, and allowed to remain exposed 106 days. At the end of this time the surface of the lead was unaltered, except, as in Exp. 9, just above the level of the water, where a slight white incrustation of carbonate existed. The water was clear: there was no precipitate: and, on drying the lead, it was found to have undergone no appreciable alteration in weight. No residue was obtained on filtering the water; and, either filtered or unfiltered, it was unaffected by sulphuretted hydrogen gas.

Exp. 12.—In this experiment, the lead remained in the water 207 days. The metal had the same appearance as when first immersed: no carbonate was formed. The water was clear; and, on testing it with sulphuretted hydrogen, there was no salt of lead, either dissolved, or mechanically diffused through it—at least so far as this test is capable of detecting the salts of lead.

Exp. 13.—This experiment was parallel to that of Exp. 7, and performed at the same time, to allow of a comparison being instituted in respect to the results. The lead introduced into river water remained exposed to air 242 days. On examining the metal at this time, it had undergone no appreciable change : no carbonate had formed : the water was clear; and, filtered or unfiltered, it gave no indication of the

presence of lead when sulphuretted hydrogen was passed into it.

This last is the longest period at which I have chemically examined water exposed to air in contact with lead : and we find by it, that in eight months no appreciable quantity of carbonate, or any other salt, was formed. Dr. Christison remarked, that lead might remain for thirty-five days in the water of the strongest spring of Airthrey, without being acted on. This water contains so much as $\frac{1}{77}$th of its weight of saline matters, chiefly sulphates and muriates. The water of Edinburgh, containing $\frac{1}{13000}$th only of saline matters, he found to possess but a feeble action on lead. The metal placed in this water began to lose weight, to a fractional extent, in seven days, and, at the same time, to become dull on its surface. This went on increasing for twenty-one, thirty-five, and sixty-three days. In another experiment, 145 grains of lead, kept for six months in six ounces of Edinburgh water, lost only $\frac{1}{15}$th gr.; but the vessel acquired a whitish incrustation, which was turned black by hydrosulphuret of ammonia. He thence infers that the Edinburgh waters may be kept for a few days in leaden cisterns, without the slightest risk ; but, after a long period, it may acquire a degree of impregnation, sufficient to render it improper for culinary purposes. It is reasonable to suppose that the action of hard water on lead will vary according to the nature and proportion of its saline ingredients. So far as the experiments related in this paper will allow me to speak, I have not found that the Thames water acquired any impregnation of lead, even after eight months' contact with the metal. But it may be fairly asked, whether inferences derived from experiments performed on this small scale can be made applicable to those cases in which vast quantities of water are exposed in extensive leaden reservoirs or cisterns. Undoubtedly, such inferences should be cautiously applied ; and we shall perhaps best examine this question by considering under what circumstances carbonate of lead may be formed through the medium of *hard* water. In Exps. 9 and 11, it was remarked, that the lead, above the level of the water, had acquired a slight coating of carbonate. This is owing to the same cause

which produces the white incrustation just above the level of water in every leaden cistern containing spring or river water; and which also gives rise to the formation of a dense crust of carbonate upon the interior of the leaden cover of every small cistern. The cause has been satisfactorily explained by Dr. Christison. The water which rises by evaporation is of the nature of distilled water; and consequently, where it meets with an exposed surface of lead, it gives rise to the production of carbonate. Now, this crust of carbonate being but loosely attached to the metal, and a large quantity of it being formed in an extensive cistern, the water may in time acquire a poisonous impregnation, owing to its becoming detached by atmospherical causes.

But, supposing hard water to be cut off from the access of air, as where it is circulated through leaden pipes, is it likely to give rise to the formation of this poisonous salt ? Mérat, a French writer on the subject, thought that water could not act on lead under these circumstances ; but although there is certainly less risk, yet it is at the same time established, that a continual renewal of aërated water (and all hard water is of this character) may, in the course of time, give rise to the formation of carbonate. In new leaden pipes, the effect would be more rapid than in those which have been in use for a long period, and which, probably, have their interior surface protected by the deposition of sand, mud, or incrustations of some of their saline ingredients.

In the transmission of water through pipes, it has been remarked, that the poisonous impregnation takes place with greater rapidity in those cases where the pipes have a fall; owing, doubtless, to the crust of carbonate being continually removed by the force of the falling water.

Another cause for the contamination of hard water, is assigned to the presence of a large quantity of carbonic acid. Carbonate of lead has not only a greater tendency to form in a carbonated water ; but an excess of carbonic acid tends to favour the solution of the poison. Nevertheless, there is a wide difference, in this respect, between distilled and hard water, when equally saturated, by artificial processes, with carbonic acid.

Exp. 14. — A quantity of *distilled* water was saturated under pressure with carbonic acid. A piece of lead was introduced, and the vessel exposed. In eight days a tolerably firm crust of carbonate had formed, and adhered to the lead. It was not easily detached by agitation. The water was clear. In fifty-one days, a very large quantity of crystalline carbonate had formed, which partly encrusted the surface of the lead, and was partly deposited at the bottom of the vessel. The filtered water gave a brown discolouration with sulphuretted hydrogen; while the unfiltered liquid gave, after a time, a dense black precipitate of sulphuret of lead.

Exp. 15.—An equal quantity of river water was saturated with carbonic acid at the same time, and a piece of lead immersed in it. After three days' exposure, but little change had taken place; in fifty-one days, the surface of the metal was tarnished, the water was slightly milky, and some carbonate of lead had evidently formed; but the deposit was most striking on the metal immediately above the level of the water. The unfiltered liquid gave a brownish precipitate with sulphuretted hydrogen; the filtered, but a very faint discolouration.*

The results are what might have been anticipated, in regard to distilled water; but we see that hard water, containing carbonic acid, is more exposed to impregnation by lead, than that which is destitute of it. This may account for the large quantity of carbonate of lead extracted by MM. Barruel and Mérat from some of the Parisian water, which had been allowed to stand for two months in a leaden cistern. The water of Paris, especially that supplied by the aqueduct of Arcueil, which I have had an opportunity of examining, abounds in carbonic acid; and, were it not for the presence of a large quantity of carbonate of lime, this water would be speedily contaminated in a leaden cistern, or by passing through a leaden pipe. Devergie† satisfactorily

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* Had the vessels containing the carbonated water and lead, in these two cases, been closely corked, doubtless a much larger quantity of carbonate of lead would have formed, and within a shorter period. Having, however, a practical object in view, the water was here treated as a carbonated spring water would be treated on a large scale, when required for domestic use.

† Médécine Legale, II. 777.

accounts for the preservative effect of the carbonate of lime, by representing it as being deposited in a firm crust on the interior of the pipes. It thus forms, as it were, a calcareous pipe for the transmission of the water; and until such a crust has formed, the use of water transmitted through the pipes might be attended with dangerous consequences. The close deposition of insoluble earthy impurities would be followed by the same results; and it is, perhaps, to an incrustation of this kind, mixed with more or less saline matter, that the water circulated through the leaden pipes of the houses of this metropolis owes its comparative purity and absolute freedom from lead.

Water containing much carbonic acid, whether pure or hard, is liable to acquire dangerous properties, by transmission through leaden pipes, especially if newly laid down. It is related by Sir G. Baker, that, owing to a circumstance of this nature, several fatal cases of colic occurred in the family of Lord Ashburnham some years since.

It is said, that when hard water has been allowed to remain a long time in a leaden vessel, it will acquire an impregnation of some poisonous salt of lead, which may render it dangerous for use. From the manner in which water is supplied in the metropolis and other large towns, it is scarcely probable that it would become in the least affected; and, if it were so, the effect would be probably due to a portion of carbonate having been washed off from the cistern immediately above the ordinary level of the water: for, so far as my observations have extended, on several specimens of water supplied in different parts of the metropolis, they all appear to have an equal power of resisting the action of lead, at least for five or six weeks together; and longer than this, it is rare that water would require to be preserved. There is, however, a point to which I must here advert, as it does not appear to have been hitherto noticed. Unless a cistern be kept regularly supplied, and filled, at short intervals, to nearly an equal level, the use of the water might become, occasionally, dangerous. If, for example, a cistern remain empty for twenty-four or forty-eight hours, the whole interior may become incrusted with extensive patches of carbonate of lead, which may be removed by, and mecha-

nically diffused through the water, on its next entrance. The same effect will follow, if the level of the water be subject to frequent fluctuations. It is, I believe, to a cause of this nature, that we are to ascribe the occasionally-poisonous impregnation which hard water acquires; and many accidents, reported to have occurred in the navy, are doubtless to be traced to it.

But there are certainly other cases, in which hard water may act upon lead. One of these is, where the saline ingredients are in very small proportion. It is impossible to assign an exact limit to the preservative power of the saline matter contained in hard water; since this, as we shall presently see, not only varies according to the *proportion*, but according to the *chemical* nature, of the ingredients. The water supplied to Tunbridge, according to the analysis of Thompson, contained only $\frac{1}{350000}$th of saline matter; and the fact adverted to by Dr. Christison, of the water having become impregnated with lead, in its transmission through a quarter of a mile of leaden pipe, is perhaps to be explained, as he suggests, by a reference to the very small quantity of saline matter contained in it. In this instance, many cases of lead colic occurred among the inhabitants of Tunbridge, who received their supply of water through the leaden pipes. Iron pipes were substituted; and the disease soon afterwards disappeared[*].

Although the Edinburgh water contains not more than $\frac{1}{13000}$th of saline matter, it has, as we have seen from experiments quoted, but little action on lead. The Thames water, employed in my own experiments, contains about $\frac{1}{7000}$th, and has even less action. Being desirous to ascertain how far this property might become impaired by dilution, a quantity of river water was well mixed with an equal weight of recently-distilled water.

Exp. 16.—A piece of lead was introduced into this mixed water, and the vessel exposed. In forty-four days the water was examined. The lead presented the same appearance as when immersed. There was no perceptible formation of carbonate. When filtered, the water underwent no change by

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[*] Christison, 396.

transmitting through it sulphuretted hydrogen. A portion of the unfiltered water thus treated acquired the very faintest discolouration.

It is thus reasonable to infer, that a water containing one-half of the proportion of saline ingredients contained in this river water, provided the ingredients were of the same chemical nature, would be able to resist, at least for a considerable period, the corrosive action of lead. A quantity of hard water might thus confer upon rain water the power of resisting the formation of carbonate.

Whether an unusually large proportion of saline ingredients will give rise to a chemical action between hard water and lead, is a point which has not been examined; but it appears to me that this is not improbable; at least, in respect to certain salts.

The last experiment connected with the action of hard water was made with the design of ascertaining whether, if the water were deprived of the gases it contained, by heat, and the lead were put in while the water was heated, any difference would be observed in its preservative power.

Exp. 17.—A piece of lead was put into river water, which had been kept for some time boiling, and while still hot. It was allowed to cool gradually, and remain exposed. Fifty-five days afterwards, the surface of the lead had undergone no change; but a light flocculent matter was loosely floating in the water. The filtered water was not affected by sulphuretted hydrogen; but a portion unfiltered acquired a faint brown discolouration.

The result of this experiment would appear to shew that hard water, deprived of air, and allowed to cool in contact with lead, is liable to gain a slight impregnation of the metal. The difference, however, was very trifling.

When we come to examine why hard water will not act on lead like distilled water, we can only find an answer, by referring the difference to the presence of saline ingredients in the former. Hard water, when deprived of these by distillation, speedily acts upon the metal. The manner in which these saline ingredients operate, it is not so easy to determine. They certainly do not appear to act by any interchange of affinity with oxide of lead; because no oxide

of lead is formed; nor can any salt of lead be detected, under the instances mentioned, either in the water, or deposited on the metal, after many weeks', or even months' exposure. They most probably, therefore, act by destroying that catalytic power which distilled water is assumed to possess. In distilled water, the carbonate of lead continues to be formed; because, as carbonic acid and oxygen are removed from the water by combining with the lead, there is no impediment to the continued absorption of fresh quantities of those gases. But all hard water contains a certain portion of oxygen and carbonic acid; and there is no reason to suppose that the Thames water, employed in these experiments, did not contain, in the first instance, as much of those gases as the exposed distilled water used in some of the experiments: yet, how different were the effects! The difference can, then, only be ascribed to the saline matters preventing the union of the oxygen and carbonic acid, contained in hard water, with the lead; not to their preventing the absorption of those gases from the air: for, doubtless, if by any cause the oxygen and carbonic acid were removed from hard water, fresh portions would be speedily absorbed, until the water was saturated. If it be difficult to explain why so minute a proportion of saline matter in water should prevent the ordinary play of chemical affinities, it will be still more difficult to assign a reason why some salts should possess this property in a higher degree than others; since neither the saline matter as contained in natural water, nor the lead, undergoes any change during exposure.

Guyton-Morveau was the first to observe that a preservative power might be conferred on the purest water by adding to it a minute portion of sulphate of lime. He found this also to be the case with regard to the muriate of soda. Dr. Christison, in experiments already referred to, ascertained that most of the neutral salts possessed this preservative power, even when employed in the smallest fractional proportions; and that some possessed it in a much more remarkable degree than others. Phosphate of soda, and hydriodate of potash, acted effectually in the proportion of $\frac{1}{30000}$th part: while the nitrate of potash, in order to prevent the action of water entirely, required to be in the proportion of $\frac{1}{100}$th.

He considered that the preservative power depended more upon the acid than upon the base of the salt; and thus he found the sulphates of soda, magnesia, and lime, to possess nearly equal preservative powers. The differences in this power among salts he ascribed to the tendency of the acid of the salt to form a soluble or insoluble compound with the oxide of lead. Those, the acids of which formed soluble compounds, were the least energetic—as the nitrates: while, on the other hand, the greatest protecting power was displayed where the acid of the salt was capable of forming a very insoluble compound with the oxide of lead—as in the case of the phosphates and sulphates. By the preservative power, in these instances, it is not meant to be said, that the lead is wholly un-acted on; but, as explained in the first part of this paper, the metal becomes slowly withdrawn from the contact of water by the formation of a sulphate or phosphate of lead, as the case may be, upon its surface; the new salt being, however, always more or less mixed with a portion of carbonate. Dr. Christison did not find, in any of those cases where the salt was used in proper proportion, that there was any lead, either dissolved in water, or floating in it, or united with the insoluble matter left on the side of the glass by evaporation. The preservation of the lead from further corrosion, and of the water from impregnation, he found to be complete*.

In the following experiments I endeavoured to ascertain the effects of bases and acids separately, mixed with pure water, as well as the effect of certain salts in retarding or preventing the chemical action of air and water upon lead. The bases employed were potash, soda, and lime.

Exp. 18.—One grain of pure potash was mixed with rather more than four ounces of distilled water; the solution being made to contain about $\frac{1}{3000}$th of its weight of alkali. It was destitute of taste, and had a very faint alkaline re-action. For a week, no change appeared to take place, with the exception of a slight tarnishing of the surface of the lead introduced. A white incrustation slowly formed on the metal, and a pre-

* Op. cit. 388, et seq.

cipitate began to be deposited at the bottom of the vessel. In forty-eight days, the lead had acquired a tolerably firm crust; and an abundant precipitate had fallen. On examination, the crust, as well as the precipitate, was found to consist exclusively of carbonate of lead. The water, filtered, was turned slightly brown by sulphuretted hydrogen; but the unfiltered liquid was abundantly precipitated, of a brownish black colour.

Exp. 19.—One grain of pure soda was dissolved in rather more than four ounces of distilled water, bringing the solution to about $\frac{1}{3000}$th; and a piece of lead was introduced. The water, which was tasteless, had a very faint alkaline reaction. In four days, the water contained diffused through it minute brilliant crystalline scales, so fine as to present iridescent colours: the lead itself was not incrusted. Soon after this, changes similar to those observed in the preceding experiment appeared to go on; and on the forty-eighth day, the bottom of the vessel was covered with a dense crystalline deposit, while the surface of the lead was coated. The water had a very feeble alkaline re-action. The crystalline substance formed, was proved to be carbonate of lead. The filtered water was discoloured by sulphuretted hydrogen: the unfiltered was abundantly precipitated, of a brownish black colour, by that gas.

Exp. 20.—A quantity of lime was dissolved in distilled water, so as to bring the solution to about $\frac{1}{3000}$th; and a piece of lead was immersed. The surface of the water soon acquired a film, evidently from the carbonic acid of the air combining with the base. A white flocculent precipitate began, in a few days, to collect about the lead; and when examined, after the lapse of forty-eight days, this was found to have considerably increased. The precipitate, on examination, proved to be a mixture of the carbonates of lead and lime; the former predominating. The filtered water was not affected by sulphuretted hydrogen; but the unfiltered was freely precipitated, owing to the formation of sulphuret of lead.

Exp. 21.—In this experiment, the lime, dissolved in dis-

tilled water was calculated to form $\frac{1}{1500}$th of the solution. The changes which it underwent were very similar to those observed in the last case, but the precipitate of mixed carbonates was more abundant. The unfiltered liquid alone was found to contain lead, by passing in sulphuretted hydrogen.

These results will probably suffice to shew, that bases of themselves have no power of preventing the action of water on lead. Perhaps the formation of carbonate is a little retarded; but, in the end, the quantity formed is equivalent to that produced by distilled water alone. In the case of lime, the filtered water was not affected by sulphuretted hydrogen; and it was remarked, that the unfiltered water gave a much less abundant precipitate of sulphuret than in the cases of potash and soda.

In respect to *acids*, the effect of carbonic acid in water has been already adverted to. The remaining acids here experimented with, were, the nitric, sulphuric, and muriatic.

Exp. 22.—A quantity of nitric acid was mixed with water, to bring the solution to $\frac{1}{4000}$th. In the course of a week, a whitish crust had formed on the lead, which was not easily detached; and above the level of the water, a small quantity of carbonate was deposited on the metal. The water, however, was perfectly clear. After the lapse of fifty-one days, the lead was found completely incrusted with carbonate; and a precipitate of this salt had become deposited at the bottom of the vessel. On filtration, the water was precipitated by sulphuric acid, indicating, that a portion of nitrate was held dissolved; as well as by sulphuretted hydrogen. It need hardly be observed, that the latter re-agent gave rise to the formation of a copious precipitate of sulphuret in the unfiltered water.

Exp. 23.—Here the nitric acid formed $\frac{1}{2000}$th of the solution. The changes observed were much the same as in the preceding case. The surface of the lead, which was abundantly coated with a loosely attached carbonate, presented a beautiful crystalline appearance, resembling that produced on the surface of tin-foil or bismuth by diluted nitric acid. The filtered water yielded with sulphuric acid and sulphuretted hydrogen more abundant precipitates than in Exp. 22; the lead having remained for the same period of time in the water.

Dr. Christison had already observed, that water acidulated with $\frac{1}{800}$th or even $\frac{1}{7000}$th of sulphuric acid acted much less rapidly on lead than when quite pure. The following experiments confirm the correctness of this view.

Exp. 24.—A piece of lead was exposed in distilled water, containing about $\frac{1}{1500}$th of its weight of sulphuric acid calculated as anhydrous. The water was tasteless, but faintly acidulous. In twenty-four hours, that portion of the metal immersed had become covered with a fine white filmy coat. In twelve days, the coating had increased; but no carbonate had been produced, and the water remained quite clear. In fifty-five days, a white precipitate had formed, and was partly attached to the lead. The precipitate was found to consist of carbonate and sulphate of lead. The water filtered was turned faintly brown by sulphuretted hydrogen; —unfiltered, of a deep brown colour.

Exp. 25.—Water containing $\frac{1}{500}$th of sulphuric acid was here employed. The lead became similarly incrusted; and after fifty-five days, the crust had increased, but the water was clear; the precipitate being, with the exception of a very small portion, attached to the surface of the metal. The precipitate was found to consist of sulphate and carbonate of lead. In the unfiltered state, it was immediately precipitated by sulphuretted hydrogen; but when filtered, it acquired, as in the former instance, only a faint discoloration.

Muriatic acid was found by Dr. Christison to be somewhat more active as a solvent. Distilled water containing $\frac{1}{300}$th of the acid acquired in thirty-two days a sweetish taste; and yielded, by evaporation, a considerable quantity of muriate of lead; while the lead-rods employed by him lost weight, and were covered by acicular crystals of the same salt.

Exp. 26.—A piece of lead was put into distilled water containing $\frac{1}{4000}$th of muriatic acid. In a week, a yellowish-white incrustation had formed on the surface of the metal immersed. This was found not to be easily detached by agitation. In fifty-one days, the lead was completely coated; and there was an abundant white precipitate, which rendered the water turbid, when slightly agitated. On examination, this precipitate

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was found to consist chiefly of carbonate. The filtered solution
gave a precipitate with sulphuric acid, and the sulphates,
shewing the presence of a soluble salt of lead : it was also
abundantly thrown down by sulphuretted hydrogen gas.

Exp. 27.—The water in which the lead was placed, in this
instance, contained $\frac{1}{500}$th of muriatic acid.   The changes
which took place in the metal were much the same as in the
preceding experiment.   At the end of fifty-one days, the
precipitate was more abundant, and appeared to contain more
chloride.   There was, however, a large quantity of crystalline
carbonate loosely adhering to the metal.   The water evi-
dently contained chloride of lead ; and when filtered, it was
immediately precipitated white by sulphuric acid and the
sulphates ; and black, by sulphuretted hydrogen gas.

We find, then, that the three principal mineral acids not
only have no power of preventing the usual action of water on
lead, but that they actually form with the oxide of the metal
salts, which become either dissolved or precipitated.   After
the neutralization of the free acid by the formation of these
salts, the production of carbonate continues so long as any
portion of lead is exposed.   In the case of sulphuric acid, the
change is certainly retarded, owing to the sulphate formed
closely investing the surface of the metal.   In the end, the
water acquires an impregnation of lead ; which is strong in
proportion to the solubility of the salt formed by the union of
the free acid with the oxide of lead.   Thus, *cæteris paribus,*
more lead is dissolved in the case of nitric, than of muriatic
acid ; and more in the employment of either of these acids,
than in the case of sulphuric.

Having thus arrived at the conclusion, that neither the
most common acids nor bases have the power of preserving
water from contamination with lead, we may next proceed to
inquire whether they have this power in the combined or
saline state, and to what degree respectively.   For this pur-
pose, I selected some of the more common salts.

Exp. 28.—A solution of carbonate of potash was made in
distilled water, in the proportion of $\frac{1}{500}$th of the salt.   In a
few days, the lead became very slightly tarnished, but the
water remained clear.   At the termination of the experiment,

on the forty-fourth day, a white precipitate had formed, but not to any great extent; and the surface of the lead was not more coated than it had been observed to be a few days after the commencement of the experiments. When filtered, the water was turned faintly brown by sulphuretted hydrogen; but unfiltered, it was deeply coloured by that gas.

Exp. 29.—Nitrate of potash was dissolved in distilled water, so as to form a solution of $\frac{1}{5000}$th. In three days, an abundant white incrustation, evidently of carbonate, had formed on the lead. On the forty-fourth day, the water was found to be very turbid, from loosely-diffused carbonate; and the lead to be considerably incrusted. The filtered water was not precipitated by sulphuric acid or the sulphates, and was but little affected by sulphuretted hydrogen; sufficient to shew, however, that some salt of lead was dissolved, probably the carbonate. The unfiltered water was speedily and abundantly precipitated black by sulphuretted hydrogen gas.

The next experiments were on the *sulphates* of potash, soda, lime, and magnesia.

Exp. 30. — Sulphate of potash was dissolved in distilled water, in the proportion of $\frac{1}{5000}$th. At the end of a week there was no apparent change, either in the water or the metal; and when examined on the forty-fourth day, the lead had the same appearance which it presented when first placed in the water. No visible incrustation had formed upon its surface; and the water was, to all appearance, clear and uncontaminated. When filtered, it underwent no change on passing into it sulphuretted hydrogen; and in the unfiltered state it only acquired a faint brownish discoloration.

Exp. 31.—A solution of sulphate of soda in distilled water was made in the proportion of $\frac{1}{5000}$th, and a piece of lead introduced. The metal and the water appeared to have undergone no change, when examined forty-four days afterwards. The filtered water was not affected by sulphuretted hydrogen; but, as in the former case, the unfiltered water was turned faintly brown.

By a longer residence in water, however, the lead was found to become acted on.

Exp. 32.—A piece of lead, weighing 217 grains, was placed in distilled water, holding in solution about $\frac{1}{400}$th of sulphate of soda. For a long period, no change was observable; further than a loss of water by evaporation, which was occasionally made up. At length the lead began to acquire a firm white incrustation, not easily removed by agitating the vessel; and it was found, 106 days after the commencement of the experiment, that a crystalline precipitate had formed, and had become firmly attached to the bottom and sides of the glass. The lead was, as is usually the case, more incrusted on its upper surface than on the under. The precipitate consisted of carbonate and sulphate of lead; the former being in greater proportion. When the metal was deprived of its adhering crust, it was found to weigh 214 grains. It had, therefore, lost three grains. The filtered water was not perceptibly affected by sulphuretted hydrogen; but unfiltered, it was precipitated brownish black.

Guyton Morveau and Dr. Christison both found that sulphate of lime had good preservative powers; the former, in the proportion of $\frac{1}{500}$th; the latter, of $\frac{1}{400}$th in pure water. The following experiments will serve further to establish the fact.

Exp. 33.—Sulphate of lime was dissolved in distilled water, in the proportion of $\frac{1}{500}$th. Neither the lead nor the water underwent any change; and on the forty-eighth day, the water was tasteless, clear, and to all appearance the same as when first put into the vessel. In the *unfiltered* state, it was not affected by sulphuretted hydrogen gas. In a parallel experiment, made at the same time with a portion of the same distilled water, carbonate of lead was formed, and the unfiltered water was abundantly precipitated.

Exp. 34.—Here the sulphate of lime formed $\frac{1}{500}$th. The lead remained in the water forty-eight days; and the surface of the metal was the same as when put in. No carbonate appeared to have formed; and the water was clear. The water filtered was not affected by sulphuretted hydrogen: unfiltered, it acquired only the faintest brown tinge.

Exp. 35.—The sulphate of lime was, in this case, used in the proportion of $\frac{1}{500}$th. In forty-eight days, no change had

taken place, either in the appearance of the lead or the water. The unfiltered water was not affected by sulphuretted hydrogen.

Exp. 36.—A piece of lead, weighing 186 grains, was introduced into a few ounces of distilled water, holding in solution $\frac{1}{200}$th of sulphate of lime. After some months' exposure, the loss of water by evaporation being occasionally made up, a white crust began to form on the lead, which was found to be firmly adherent. At the end of 234 days the vessel was examined: the lead had lost but little in weight, when the crust was removed. Some rings of a white substance had formed on the sides of the glass. The deposit on the lead was found to consist of carbonate and sulphate. Neither the filtered nor the unfiltered water gave any traces of lead on passing in sulphuretted hydrogen; but the white spots adherent to the glass were turned black by the gas.

Exp. 37.—A piece of lead was introduced into distilled water, containing $\frac{1}{300}$th part of sulphate of magnesia. After forty-four days' exposure, the vessel was examined. The surface of the lead was free from any incrustation, and the water was quite clear. No carbonate had apparently formed. The filtered water was unaffected by sulphuretted hydrogen; but unfiltered, it acquired from the gas a slight brown discoloration.

Exp. 38.—In this experiment, phosphate of soda was the salt employed; and it was dissolved in distilled water, in the proportion of $\frac{1}{700}$th. In the course of a few weeks, a crust had evidently formed on the lead, but the water remained clear. In 234 days, the crust had only slightly increased: it was found to consist of phosphate and carbonate. The filtered water was slightly affected by sulphuretted hydrogen.

Exp. 39.—Lead was placed in water holding about $\frac{1}{400}$th of chloride of sodium. In a few days, a crust began to form on the surface, which for some weeks slowly increased. White acicular crystals, in tufts, then attached themselves to various parts of the metallic surface; and a white crystalline precipitate slowly fell to the bottom of the vessel. In 234 days, the crystalline crust on the lead had much increased. It was found to be formed, as well as the deposit, of chloride and

carbonate of lead. The filtered and unfiltered water was precipitated by sulphuretted hydrogen. The weight of the lead employed was 210 grains:—it was now reduced to 205 grains.

Exp. 40.—The chloride of sodium was, in this case, used in the proportion of $\frac{1}{1800}$th. The water was tasteless. It was exposed for the same period as in the foregoing experiment; and the changes which ensued were very similar. The formation of chloride was more abundant. The lead weighed, when immersed, 189 grains: it now weighed 183 grains; so that it had lost 6 grains. On examining the washed surface of the metal, several depressions, evidently resulting from corrosion, were observed in it. The filtered and unfiltered water was freely precipitated by sulphuretted hydrogen.

From a consideration of the results of the preceding experiments with neutral salts, I think it will be evident that the carbonate and nitrate of potash, although they undoubtedly retard the formation of a poisonous salt of lead, must be rejected for practical purposes. The same observation might apply to the chloride of sodium; although the lead, it is true, in these cases, was submitted to a much longer trial than would be ever likely to be demanded: yet, in consequence of the easy access to this salt, and the ready manner in which it may be employed, Dr. Christison's observations with respect to it cannot be too widely circulated. A few grains dissolved in water prone to corrosion by lead, although insufficient to confer taste, or interfere with the ordinary uses of the water, will allow of its being kept a sufficient time in a leaden cistern for domestic purposes, without exposing the parties using it to any risk of lead-poisoning. From the results obtained by that gentleman, the salt should not be used in a less proportion than $\frac{1}{3000}$th part of the weight of the water—a quantity insufficient to be perceived by the taste.

Phosphate of soda is also a good preservative: although, in Experiment 38, its powers were put to a severe trial, the water having been kept nearly eight months.

Of all the neutral salts, the sulphates appear to me to

deserve the preference, as artificial preservatives. But, among these, the sulphates of lime and magnesia preserve better, *cæteris paribus*, than those of potash and soda; and the sulphate of lime is, I think, to be preferred to that of magnesia. In three of the experiments performed with varying proportions of this salt, the metal and the water remained as free from carbonate, or any other saline impregnation with lead, as if spring or river water had been employed; although exposed, in a wide-mouthed vessel, to the open air for forty-eight days. In one experiment only was the *unfiltered* water affected by sulphuretted hydrogen; but that to so slight a degree, as scarcely to call for notice. Even after eight months' exposure, although some sulphate and carbonate had formed, yet none had become dissolved or diffused in the water, so as to render it discoverable by sulphuretted hydrogen. A similar observation was made by Dr. Christison in respect to this and other preservative salts*. It appears to me, therefore, that any water liable to be acted on by lead, owing to its being particularly soft or free from saline matter, might have this property corrected, by adding to it a small quantity of a solution of sulphate of lime. If the water contain much carbonic acid—and, more especially, if the cistern be close, or if the water containing this gas have to traverse leaden pipes—preservative salts will be but of little avail, in preventing it from acquiring a poisonous impregnation of carbonate. The constituents of sulphate of lime are known to be present in almost all kinds of river and spring water; and probably to this may we chiefly ascribe the want of action of such water on metallic lead. The hardness of water causes it often to be condemned or abandoned for domestic purposes; but it has not been sufficiently considered, in making the objection, that this very circumstance is the means of preventing those who receive it through leaden pipes, from suffering from a most insidious, dangerous, and often fatal malady †.

* On Poisons, p. 389 et seq.

† There is a difference in the action of river-water upon lead, and water rendered artificially hard by the addition of the preservative salts mentioned. In river-water, I have never remarked any deposit, either on the lead or on the glass, or any salt of lead formed within the water. In water artificially
prepared,

Considering that iron had the property of displacing lead from its saline combinations, I performed the following experiment, in order to see how far the corrosion of lead by distilled water might be prevented by that metal.

Exp. 41.—Some clean iron wire was wrapped round a piece of sheet-lead, so as to form several close coils. It was then placed in distilled water, being only partially immersed. In three days, the iron was already much corroded, but the lead did not appear to have become attacked. The sesquioxide of iron now began to fall down abundantly, collecting at the bottom of the vessel. In forty-four days, the iron was almost entirely oxidized, but there was no appearance of carbonate of lead: the lead, when examined, had undergone no change whatever. The water filtered, left an abundant residue of sesquioxide of iron on the filter. The water thus freed from the oxide was not in the least affected by sulphuretted hydrogen gas. Ferrocyanate of potash did not produce any effect when added to it.

From this experiment, so far as a single result will allow an inference, it would appear that iron may prevent the corrosion of lead in cisterns containing water disposed to this change. How far it might apply to a water highly charged with carbonic acid gas, I have not had an opportunity of examining. One inconvenience would attend the use of metallic iron as a preservative; namely, the formation and subsequent collection of a large quantity of the oxide of that metal in the cistern. It is, however, a perfectly innocent substance; and if even mechanically mixed with water, in culinary operations, it would not be productive of mischief like the carbonate of lead. A temporary inconvenience must, therefore, be balanced against a very probable source of danger. Still, it appears to me a question worthy of examination,

prepared, the lead becomes, in the progress of time, coated by a layer of insoluble salt, which prevents further action, unless accidentally detached. In the case of sulphate of lime, some months may pass without this change being observed ; but finally it takes place to a greater or less extent. The saline matter in river-water then operates by preventing all chemical action : the artificial mixture only prevents this for a time: but the period is much longer than that for which water is ordinarily required to be preserved.

whether, if leaden pipes were used for transmitting a su-
spected water to any distance, it would not be advisable to line
a portion of their interior, at proper interspaces, with rings or
tubes of sheet iron. As it is, from the serious accidents which
have befallen families, or even a village population in certain
localities, where leaden pipes have been used for conveying
water, prudence has often led to the entire removal of this
metal, and the substitution of iron.

I shall observe in conclusion, in order that others may
judge how far the inferences from the experiments related in
this paper are justifiable or warranted by the facts, that the
lead employed was the ordinary commercial lead, cut into
pieces of about one-eighth of an inch thick, about half-an-inch
wide, and four or five inches long; that the distilled water
was recent, yielding no precipitate by the usual tests; and
the hard water rendered as clear as possible by repose. The
quantity of water employed in each experiment varied from
four to six ounces; and the glass vessels employed were with
wide mouths, so as to allow of the freest access of air. The
lead was used with a clean surface; but it was not, except
when specially mentioned, rendered perfectly bright by
scraping, previous to immersion. Had this been the case,
probably the effects would have been more striking, and a
larger quantity of carbonate would, perhaps, have been formed
in some of the experiments. I used it in that condition in
which it is employed by the plumber for the making of cis-
terns; or as we are accustomed to see it in new leaden pipes,
in which its lustre is not entirely lost.

ON

THE EFFECT PRODUCED UPON THE

PULSE

BY

CHANGE OF POSTURE:

BEING PART OF A PAPER READ BEFORE THE PHYSICAL SOCIETY OF GUY'S HOSPITAL, IN THE MONTH OF OCT. 1837.

BY WILLIAM AUGUSTUS GUY, M.B. Cantab.

THE ancients examined the pulse with as much care, and described the various changes which it undergoes, with as much accuracy as the moderns have done; but ignorance of its true nature robbed their observations of all their value, and the fallaciousness of the pulse passed into a proverb. The discovery of the circulation of the blood removed this source of fallacy; but left another untouched, which remains as great at the present day, as in the time of Hippocrates. The pulse, itself a minute object, undergoes minute changes; and these are to be estimated by the least certain of our senses, and described in language by no means remarkable for precision. Fortunately, however, there is one character of the pulse, concerning which, as Heberden has justly observed, we can neither deceive ourselves, nor be misunderstood by others;—I mean, its frequency:—to this, therefore, our best attention ought to be given. But even this character of the pulse could not be rendered available till nearly a century had elapsed after the discovery of the circulation. Floyer's invention of the Pulse-watch, at the beginning of the eighteenth century, supplied this great desideratum, conferred upon the pulse its only character of certainty, and furnished us with an instrument whereby the various changes which the circulation of the blood undergoes might be measured with at least some approach to accuracy.

Amongst the questions connected with the frequency of the pulse, one of the most interesting, and perhaps not the least important, is the effect produced by change of posture. Although this subject has

been frequently discussed, it is by no means exhausted : the investigation, instead of being completed, has still to be begun : for neither the amount of the effect produced, the circumstances by which it may be modified, nor the cause to which it is attributable, has yet been examined with sufficient care.

A variety of observations might be gleaned from the works of Galen, Falconer, Darwin, Baildon, and others; which, while they prove that in disease, and under the operation of remedies, the effect produced upon the pulse by change of posture has never entirely escaped attention, have long furnished a strong motive to a more careful examination of that effect in healthy persons. I shall not stop to quote these authorities; but shall confine myself to a brief statement of the observations made by preceding physiologists on the effect produced by change of posture on the pulse of persons in a state of health. For the first experiment of this kind we are indebted to Bryan Robinson*. The numbers are as follow: Standing 78, Sitting 68, Lying 64. In the Transactions of the British Association for the Advancement of Science†, Dr. Macdonnell is stated to have vindicated his claim to originality by dating his own observations on the so-called differential pulse as far back as 1784. He therefore ranks next, in order of research, to Bryan Robinson. It is to be regretted that the notice of the paper which he read before the British Association, is so short, that the nature and extent of his observations cannot be ascertained. It is probable, however, that Dr. Macdonnell is the person to whom Dr. Thomson alludes, in his work on Inflammation, as having observed that the pulse, even in healthy persons, was more frequent in the erect than in the horizontal position, by from 12 to 20 beats. Falconer‡, in a work containing many valuable remarks on the pulse, states, that " the result of twenty-one accurate trials, made on different days and at different times of the day, all coincided to prove the greater frequency of the pulse standing, than sitting or lying." " The greatest difference observed was 13 beats in a minute, and the least difference one beat. Each of these, however, occurred once only. The average difference between the above postures was about six and a third in a minute."

* A Treatise on the Animal Economy. By Bryan Robinson, M.D. *Dublin*, 1732. (p. 177.)

† Dublin Meeting, 1835. (p. 97.)

‡ Observations respecting the Pulse, intended to point out with greater Certainty the Indications which it signifies, especially in Feverish Complaints. By W. Falconer, M.D. F.R.S. Physician to the General Hospital, *Bath*. 1796. (p.34.)

He adds (p. 35): "The pulse in health is, as far as I can find, the same in a sitting as in a horizontal posture."

The person to whom the profession is mainly indebted for a knowledge of the effect produced upon the pulse by change of posture, is Dr. Knox of Edinburgh. His first publication was in the year 1815*. A second memoir has lately appeared †, and has been reprinted, with other anatomical and physiological essays, in the form of a small pamphlet, bearing date 1837. In this essay, Dr. Knox gives a repetition of his former views, "matured by an experience of more than twenty years, passed exclusively in the exercise of his profession." In his first publication, no experiments are detailed, but the general result of his observations is thus stated: —"During the morning, the mere change of posture, from the horizontal to the erect, shall increase the pulse by about 15 or 20 beats. At midday, this increase shall be 10; and in the evening, 4, or 6." In the essay published in 1837, Dr. Knox presents us with experiments made on "the midday pulse of twenty-five young gentlemen, taken between the hours of 12 and 2, in July 1836." With one exception, the subjects of the experiments were in good health. The results are as follows: Mean age, 25. Mean pulse, sitting, 72.4; standing, 75.4. There is here, probably, some error of the press, (I quote from the pamphlet), as the mean number, sitting, is 71.6, and not 72.4: this correction raises the difference between standing and sitting to 3.8 beats. Another Table, given at p.12, shews the results of four experiments made in the morning, and three in the evening, on a gentleman in good health, aged 20. The difference between standing and lying was 28.7 in the morning, and 21.3 in the evening. The difference between standing and sitting was 12 beats in the morning, and 10.67 in the evening. Between these results, and those stated in 1815 on the one hand, and the twenty-five experiments just cited on the other, there is so great a discrepancy, that I cannot but suspect the existence of some source of error. Nick‡, in a prize essay published at Tübingen in 1826, devotes a few pages to the effect of posture on the pulse. He places the difference between standing and lying, in the early part of the day, at 15 to 20 beats; and says, that this difference amounts to from 10 to 12 beats after an interval of rest. He corrobo-

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* Ed. Med. and Surg. Journal, Vol. XL.   † Ibid. No. 131.

‡ Beobachtungen über die Bedingungen, unter denen die Häufigkeit des Pulses im gesunden Zustand verändert wird. Von Georg Heinrich Nick. (p. 41.)

rates the statement of Knox, that the effect decreases as the day ad-
vances. Dr. Graves, in an essay published in 1830[*], says, that
" in healthy persons the pulse in the erect posture is more frequent
than in the horizontal, by from 6 to 15 beats in a minute. If the
pulse is but 60, the difference is generally not more than 6 or 8 ; and
the difference increases with the frequency of the pulse at the time of
the experiment. Thus, if it has been raised to 90 or 100 by mode-
rate exercise, it is not unusual to find the difference 20 or 30."
Hohl[†] details experiments made on nine pregnant women. They give
the following averages—Standing, 94 ; sitting, 83 ; lying, 77 : being
a difference, between standing and lying, of 17 beats. It would
occupy too much space, were I to quote from works on Physiology
the meagre information which their authors have derived from
treatises written expressly on the pulse. I will merely state, that the
imperfect manner in which the pulse is treated, in systematic works
on Physiology, has been one of the strongest motives to the present
attempt to confer greater certainty on the subject. The authorities
which have been quoted prove one thing at least ; viz. that the
effect produced by change of posture on the pulse of healthy persons
is considerable ; but they *prove* little more than this. Their labours
are defective in almost all the essentials of correct observation. The
experiments which they have detailed are not sufficiently numerous,
nor are the conditions under which they were performed stated with
precision : in some instances, too, their experiments are at direct
variance with their statements ; and the results at which they have
arrived, are not expressed in such a manner as to be readily com-
pared with others, or with the observations which may be made
hereafter on persons labouring under disease. In the present paper
it is hoped that some, at least, of these errors have been avoided.

The experiments which form the staple of the following remarks
were commenced in the year 1832, during my residence at Cam-
bridge ; and have been accumulating ever since that period. They
were all made on healthy males who had not eaten food for at
least two hours previously ; and had remained at rest for some
time. With few exceptions, the pulse was felt between noon and
two P.M., before the person had taken any violent exercise, or ex-
posed himself to any other cause of excitement. When any such
cause could be detected, the experiment was excluded. No two of
the reported observations were made on the same person ; but some

[*] Dublin Hospital Reports, Vol. V. pp. 561, 562.

[†] Die Geburtshülfliche Exploration von Dr. Antou Friedrich Hohl. *Halle*,
1835.

of the numbers stated, are averages of more than one experiment. The pulse was felt first in the erect, then in the sitting, and then in the recumbent posture. In the sitting posture, the back was unsupported: in the recumbent position, the head was slightly raised. Care was taken that the subject of the experiment should not remain standing longer than one or two minutes; and a short interval was allowed to elapse after each change of posture, before the pulse was counted.

The age of the persons submitted to experiment ranged from 20 to 50. Of the whole number, seventy-nine were between 20 and 30 years of age; ten between 31 and 40; and eleven between 41 and 50. The mean age was 27.24. To insure accuracy, I may state, that the experiments are not selected from a larger number, but taken in the order in which they were made. I have arranged them, however, in the Table, in such a manner, that the eye, in glancing over them, may see the principal varieties which took place*. The following, then, are the results of 100 experiments made on healthy males of the mean age of 27 years, in a state of rest, unexcited either by food or exercise.

<div align="center">Standing, 78.90   Sitting, 70.05   Lying, 66.62.</div>

Difference between standing and sitting, 8.85; between sitting and lying, 3.43; and between standing and lying, 12.28. These differences expressed fractionally—the form in which one observation can be most readily compared with another—are as follows: Difference between standing and sitting, $\frac{1}{8.91}$, or nearly $\frac{1}{9}$th, of the number of pulsations in the erect position; difference between sitting and lying $\frac{1}{20.30}$, or about $\frac{1}{20}$th of the number in the sitting posture: difference between standing and lying $\frac{1}{6.42}$, or about $\frac{1}{6}$th of the number in the erect posture. Thus, if the number of the pulse, standing, be 72, and we wish to find the probable number in the sitting posture, we must take away $\frac{1}{9}$th of 72, or 8 beats, which leaves 64 beats: if from this number we would calculate the probable frequency in the recumbent position, we must take away less than $\frac{1}{20}$, or between 3 and 4 beats, say 4. The result for the recumbent posture will then be 60; a number less than 72, by 12 beats, or $\frac{1}{6}$th part of 72.

* I take this opportunity of returning my best thanks to those Gentlemen who have kindly contributed to my stock of experiments. To my friends, Dr. Rees and Mr. King, of Guy's Hospital, and Mr. Lingen, of Hereford, I am under great obligations. Their experiments were made with the same precautions as my own.

On referring to the Table, it will be seen that the extreme are very remote from the mean results. Thus, if we take the first forty-six experiments, we shall find that the difference between standing and sitting may be as high as 26, or more than $\frac{1}{4}$th of the number of pulses in the erect position, and as low as 3 or about $\frac{1}{10}$th of that number; between sitting and lying, the difference may be as much as 18, or $\frac{1}{4}$th of the frequency sitting, and as little as 1 or $\frac{1}{60}$th of that frequency; and between standing and lying the difference may amount to 44, or little less than $\frac{1}{2}$, and be as small as 4 or $\frac{1}{14}$th of the number of pulsations in the erect position.

The results to which we have just arrived, establish the following general laws:— 1. A change from the erect to the sitting, from the sitting to the recumbent, and, *à fortiori*, from the erect to the recumbent posture, lessens the frequency of the pulse. 2. The difference between standing and sitting is greater than that between sitting and lying.—To each of these general laws there are exceptions. To the first, they are of two kinds; viz. those in which no effect is produced by change of posture; and those in which the pulse becomes more frequent, instead of less frequent, by a change from standing to sitting, from sitting to lying, or from standing to lying. The following are the exceptions which occurred in the 100 expements :—

No difference between standing and sitting, in 5 instances.

. . . . sitting and lying, in 19 instances.

. . . . standing and lying, in 2 instances.

Pulse more frequent sitting than standing, in 3 instances.

. . . . lying than sitting, in 11 instances.

. . . . lying than standing, in 5 instances.

Hence, then, to the general law, that the pulse becomes less frequent by a change from standing to sitting, there are 8 exceptions, or about $\frac{1}{12}$th of the whole number of instances. To the general law, that the pulse becomes less frequent by a change from sitting to lying, there are 30 exceptions, or $\frac{3}{10}$ths of the whole number of instances. To the general law, that the pulse becomes less frequent by a change from standing to lying, there are 7 exceptions, or about $\frac{1}{14}$th of the whole number of instances. The total number of instances, in which one or more exceptions to general rules occur, is 34, or somewhat more than $\frac{1}{3}$d of the whole number[*].

[*] That these statements may not appear at variance with each other, it must be borne in mind, that some of the experiments contain two or three exceptions to general rules.

The exceptions to the second general rule above stated, viz. that the difference between standing and sitting is greater than that between sitting and lying, are of less importance. They are as follow :

Difference between standing and sitting equal to the difference between sitting and lying . . . . . . in } 3 instances.

Difference between standing and sitting less than the difference between sitting and lying . . . . . . in } 17 instances.

If the results of experiments on the effect of change of posture on the pulse of healthy persons should ever admit of practical application in disease, the average of experiments from which the more important exceptions to general rules are excluded will probably form the standard of comparison. The first 66 experiments yield the following averages :—

<div align="center">

Mean age, 26.87

Standing, 81.03.   Sitting, 71.12.   Lying, 65.62.

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Difference between standing and sitting, 9.91, or $\frac{1}{8.17}$ of the frequency standing; difference between sitting and lying, 5.50, or $\frac{1}{12.93}$ of the frequency sitting ; and between standing and lying the difference is 15.41, or $\frac{1}{5.26}$ of the frequency standing. Thus, if the pulse in the erect posture be 80, the number sitting will be less by $\frac{1}{8}$th of 80, or 10, leaving 70 for the frequency sitting. To find the number in the recumbent posture, we must take away somewhat more than $\frac{1}{13}$ of 70, say 6 : the result for the recumbent posture will then be 64, which is less than 80, the number in the erect position, by 16, or $\frac{1}{5}$th of 80.

I should willingly have confirmed my own experiments, by comparing them with those of others. But in order that this comparison might be made, both the frequency of the pulse, and the effect produced by change of posture, should be stated; or, at least, the effect should be expressed in fractional parts of the number of pulsations in some one posture. This has not been done : the following statement, however, of the results at which others have arrived will prove interesting.

The single experiment of Bryan Robinson gives a difference of 10 beats between standing and sitting, being nearly $\frac{1}{8}$th of the frequency in the erect posture. Falconer states that difference at $6\frac{1}{2}$ beats ; and Nick, at from 6 to 8 beats. Between sitting and lying there is a difference, according to Robinson's experiment, of 4 beats or $\frac{1}{17}$th of the frequency sitting. Nick places the difference at from 2 to 3 beats, and Falconer could find no difference at all. The proportion which the difference between standing and sitting bears to that

between sitting and lying, is, in Robinson's experiment, 5 to 2: in the experiments of Knox, more than 2 to 1; and in those of Nick, 4 to 1. Graves makes the frequency sitting a *mean* between the number of pulsations in the erect and recumbent postures. Falconer, as has been already stated, could find no difference between sitting and lying. My own experiments give the proportion of about 3 to 1, when the exceptions to the general rule are included; and of about 2 to 1, exclusive of exceptions. The difference between standing and lying, is, according to Robinson's experiment, 14, or about $\frac{1}{6}$ of the frequency standing: Falconer gives $6\frac{1}{4}$; Graves, from 6 to 15; Macdonnell[*], 12 to 20; Nick, 15 to 20; and Knox, 10 for the mid-day pulse, according to his statement in his first Essay. The difference which exists between these several estimates is not greater than must always take place where the experiments from which they are deduced are limited in number, and the conditions under which the experiments were performed are not exactly stated.

Although these experiments furnish a standard of comparison which may be of essential service in the investigation of disease, a question still remains to be solved, before it can be applied with certainty; viz. Is the effect produced upon the pulse of healthy males by change of posture the same for all frequencies of the pulse? That I might decide this question, I have arranged, in a tabular form, a number of experiments, made upon healthy males of different ages; of whom some were in a state of rest, and others excited by food or exercise. Those experiments in which the pulse in the erect posture ranged between 51 and 70 inclusive were placed in one column; those in which the pulse was between 71 and 90 inclusive, in a second column; and so on. The mean results of 60 experiments (15 in each column), from which all exceptions to general rules are excluded, are given in the subjoined Table (No. III.) By referring to this table, it will be seen that there is a difference of 9 beats between standing and lying, when the average frequency of the pulse is about 60. Thus for every 20 beats there is a diminution of 3 beats. Now, if the effect produced by change of posture were the same for all frequencies of the pulse, 3 beats ought to be added to the difference for every 20 added to the frequency; and the numbers 9, 12, 15, 18 would express the effect of a change from the erect to the recumbent posture, when the pulse beat 60, 80, 100, and 120 times in a minute. The numbers determined by experiment are, however, as follows, 9, 15, 27, 39, or 9, 9 added to 6, 9 added to 3 times 6, and 9 added

[*] Quoted by Thomson, in his work on Inflammation.

to 5 times 6. This appearance of regularity is not confined to the difference between standing and lying; but the difference between standing and sitting also increases with the frequency of the pulse, in a regular proportion. Thus the numbers are, 6, 13, 19, 27; or 6, 6 added to 7, 6 added to one less than twice 7, and 6 added to 3 times 7. Other experiments made upon my own pulse, and upon that of other individuals, yield results similar to those given in the table, and enable me to state with confidence the following law: *The effect produced upon the pulse by change of posture increases with the frequency of the pulse.* The rate of increase does not admit of being expressed in general terms: if, however, the additional experiments which I am collecting confirm the results given in the table, the relation existing between the effect produced by change of posture and the frequency of the pulse may be stated symbolically*. More extensive observation must determine whether the regularity observed in the table is a mere coincidence, or a general law.

The fact, that the effect produced upon the pulse by change of posture increases with the frequency of the pulse, has been observed by

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* Let a represent the difference between standing and sitting, when the pulse in the erect posture is 60; and b, the addition made to that difference when the pulse in the erect posture is 80. Then the quantities a, $a + b$, $a + 2b$, $a + 3b$ will represent the difference between standing and sitting, when the pulse in the erect posture beats 60, 80, 100, and 120 times in a minute. Now, $a = 6$ and $b = 7$, therefore the terms of the progression are as follows:

a	$a + b$	$a + 2b$	$a + 3b$
6	$6 + 7 = 13$	$6 + 2 \times 7 = 20$	$6 + 3 \times 7 = 27$

The third term alone gives a difference of one beat between the abstract quantities and the results of actual observation.

Similarly, if a represent the difference between standing and lying when the pulse in the erect posture is 60, and b the addition made to that difference when the pulse in the erect posture is 80, the quantities a, $a + b$, $a + 3b$, $a + 5b$ will represent the difference between standing and lying when the pulse in the erect posture beats 60, 80, 100, and 120 times in a minute. As before, $a = 9$, and $b = 6$; therefore the terms of the progression are:

a	$a + b$	$a + 3.b$	$a + 5.b$
9	$9 + 6 = 15$	$9 + 3.6 = 27$	$9 + 5.6 = 39$.

In this case, the exact correspondence between the abstract quantities and the results of actual observation is remarkable: and although it may prove a mere coincidence, I entertain little doubt that the law thus symbolically expressed will prove a near approximation to the true rate of increase. The difference between sitting and lying is too irregular to admit of being expressed in abstract terms.

Dr. Graves[*]; but no attempt has been made to ascertain, by experiment, the rate of increase. The practical application, too, of the fact, and the necessity of establishing it before observations made on persons labouring under disease can have any value, have been entirely overlooked. Both Dr. Graves and Dr. Knox have regarded the effect produced by change of posture as a measure of debility. Since, however, the pulse of persons in perfect health, when raised beyond its natural frequency, undergoes changes as great as those stated to take place in cases of debility, further observations are necessary, before the effect produced upon the pulse by change of posture can be employed as an " asthenometer."

The limit of the effect produced upon the pulse of healthy males by a change from the erect to the recumbent posture may be stated at somewhat less than half the frequency of the pulse in the erect posture. The greatest effect observed in healthy males in a state of rest is 44 in a pulse of 98 : in a pulse raised by exercise to 128, the effect was 56 : the greatest *proportional* effect observed was 47 in a pulse of 101. Out of some hundred experiments {made on healthy males, I have never met with an instance in which the difference between standing and lying amounted to a half of the frequency standing. The limit, therefore, is probably less than half of that frequency.

With regard to the character of the pulse in the several postures, Dr. Graves's opinion seems to be correct. He states, that the pulse is evidently stronger in the horizontal than in the erect posture, and that, consequently, its maximum of strength and minimum of frequency are attained together [†]." Robinson [‡] also says, that " when a body first stands up and begins to move, the pulse is smaller than it was before." With a view of determining this point, I have repeatedly kept my finger on the pulse, with the same degree of pressure, before, during, and after a change from one posture to another ; and have little doubt that the pulse is less full in the erect than in the sitting, and in the sitting than in the recumbent position.

There is one fact, which, as it may throw some light on the cause of the numerous exceptions to general rules, ought not to be omitted. It is, that these exceptions become less numerous as the pulse becomes more frequent. Thus, of fifty experiments in which the pulse was

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[*] " If the pulse is but 60, the difference is generally not more than 5 or 8, and *the difference increases with the frequency of the pulse at the time of the experiment* : thus, if it has been raised to 90 or 100 by moderate exercise, it is not unusual to find the difference 20 or 30."—*Dublin Hospital Reports*, Vol. V.

[†] Loc. cit. p. 564.   [‡] Treatise on the Animal Economy, p. 178.

between 51 and 70 inclusive, 18 were exceptions; of 50 others in which the pulse was between 71 and 90 inclusive, 14 were exceptions; when the pulse ranged from 91 to 100, there were 11 exceptions; whilst there was but one exception in twenty experiments in which the pulse ranged from 111 to 130. Fifty experiments made on healthy males in a state of rest, whose pulses were between 61 and 80, gave 25 exceptions; whilst fifty other experiments on pulses ranging from 81 to 100, gave 11 only. In experiments made upon my own pulse, the exceptions were as follow:—when the pulse was between 51 and 70, there were 17 exceptions in 50; between 71 and 90, 15 exceptions; and between 91 and 110, 14 exceptions; whilst twenty-five experiments on pulses between 111 and 120 gave but 2 exceptions. *The exceptions to general rules, therefore, are more numerous as the pulse is less frequent.* I may here remark, that the same rule seems to obtain, with respect to irregular and intermitting pulses; but the experiments on which this statement rests, though sufficiently numerous to make it in the highest degree probable, do not yet amount to a sufficient number for publication.

I now proceed to discuss a question of some interest;—I mean, the cause of the different frequency of the pulse in different postures of the body. In reasoning on this subject, it is necessary to distinguish carefully between the effect due to the act of change from one posture to another, and that which results from a continuance in the several postures. More than one author has evidently confounded the one with the other; and by so doing, has rendered his ideas of the actual cause indistinct. Admitting the correctness of the most common opinion, which attributes the effect produced by change of posture to muscular contraction, it is obvious that the effort by which the position of the body is changed may mix itself up with that by which the several postures are maintained: and as, in my own experiments, the pulse was felt soon after each change of position, it becomes necessary to determine whether or not any part of the effect is due to the mere change; and if so, what part of it. This question admits of a very easy solution. Dr. Graves has already shewn, that when the posture of the body was changed without any effort of its own muscles, "the difference between the frequency in the horizontal and erect postures was not less than when muscular exertion was used [*]." The mode in which he effected this change is not stated. I submitted the question to experiment, in the following manner:—A board about seven feet in length was provided at

[*] Op. cit. p. 562.

one end with a support for the feet, fixed at right-angles to it; and
was made to revolve freely. By this means the body could be con-
veyed, without any effort of its own, from the erect posture, in which
it was supported by the contraction of its own muscles, to the hori-
zontal. An average of twenty experiments on males, whose mean age
was 16, gave the following results—Standing 88.60; lying 76.80:
difference 11.80. A mean of the same number of experiments made
on the same persons, and under precisely the same conditions as
those contained in the table, gave the following numbers—Standing
87.15; lying 74.40: difference between standing and lying, 12.75.
In the experiments made with the revolving board, the erect position
of the body was somewhat more restrained than in the common
experiment, and the head was not raised: these circumstances may,
perhaps, explain the slight difference in the result of the two classes
of experiment ; a difference amounting to somewhat less than one
beat. Since, then, the mere act of changing the posture of the body
contributes little, if at all, to the different frequencies of the pulse in
the several positions, we are brought back to the question, On what
does that difference depend? And it is not a little remarkable, that
though the effect produced by change of posture has been recognised
by so many observers, known to be considerable, and thought to be
important, no attempt has yet been made to ascertain the cause by
experiment. It is true, that the real cause has been surmised by
some, and assumed by others, but it has been demonstrated by none ;
whilst explanations have been advanced, which u moment's reflection
on the facts we already possess would have shewn to be inadmissible.

Bryan Robinson evidently assumes, that the effect produced by
change of posture is due to muscular contraction; for he mentions it
at the same time with the effect of exercise:—thus, " The pulse, in a
minute, of a man lying, sitting, standing ; or walking at the rate of two
miles in an hour, at the rate of four miles in an hour, or running as
fast as he could; were, 64, 68, 78, 100, 140, and 150 or more. When
a body stands up, the pulse begins to grow quicker the very instant
the body begins to rise, or the soul begins to exercise the power
which raises it : and when a body moves, it grows still quicker, and
the soul exercises more power to move the body, in proportion to the
quickness of the motion"[*]. Falconer[†], without distinctly stating
that the change produced by posture is the effort of muscular con-
traction, says—" Even the little effort that is necessary to preserve the
body in a standing posture is sufficient to produce a very percepti-
ble increase of pulse above what it was in a sitting or recumbent

* Op. cit. pp. 177-8.　　† Op. cit. p. 34.

posture." Knox does not hesitate to assign the same cause which is assumed by Bryan Robinson and Falconer, and surmised by the reviewer of an attempt made by Blackley to explain the effect of posture on the pulse. Such a weight of testimony would appear decisive of the question. Dr. Graves[*], however, says, that he " cannot advance even a plausible conjecture concerning the reason why a change of position should so affect the frequency of the pulse :" and adds further, that it was natural to conclude, from his experiments, " that posture alone was the cause of the retardation observed in the body when placed horizontally," p. 562 :—in other words, the effect produced upon the pulse by change of posture is due to posture. The difference in the position of the heart, or of its valves, has been also assigned by some as the cause[†]; and the more or less favourable position of the body, in respect to gravity, by others.   Arnott[‡] seems to be of this latter opinion ; for he says, " that when the heart has to send blood upwards, it requires to act more strongly than when the body is horizontal, and the pulse increases 5 or 6 beats in a minute." The facts which we already possess seem quite sufficient to decide the question against the two last-assigned causes ; for if we compare the difference between the erect and sitting postures with that which takes place between the sitting and recumbent, we shall see that the former is at least twice as great as the latter : hence, then, all those explanations must be imperfect, which depend upon conditions remaining constant where that difference is the greatest, and varying only where that difference is the least.   Now, the explanation given by Arnott, as well as the other to which I have alluded, is evidently in this predicament ; for the position of the principal vessels of the body is nearly the same in the erect and sitting posture, between which the greatest difference takes place ; but totally different in the sitting and recumbent postures, between which the difference is comparatively trifling.   The same remark applies, with equal and even greater force, to the position of the heart and of its valves.   These explanations being quite untenable, it is obvious that we must seek for a reason in some circumstance which varies as the frequency of the pulse itself varies.   Such a circumstance (and it is the only one which I know of, or can readily imagine) is, muscular contraction. That this is the real cause, is rendered probable by the reflection, that the contraction of the muscles is necessarily greater in the erect

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[*] Op. cit. p. 570.

[†] If I am not mistaken, Dr. Graves inclines to the first of these, and Blackley to the latter.

[‡] Elements of Physics, Vol. I. p. 570.

than in the sitting, and in the sitting than in the recumbent posture; and that as regards the amount of muscular contraction, the difference between the erect and sitting is clearly greater than between the sitting and recumbent positions. We are thus brought back to the cause which has been so confidently assumed, and which may appear to many persons to require no proof. The presumption, indeed, in favour of this cause is sufficiently strong. Muscular contraction increases the frequency of the pulse: now, some degree of muscular contraction is obviously required to support the body, either in the erect or sitting posture; therefore some part, at least, of the effect produced by change of posture may be justly ascribed to muscular contraction. But the question, whether any considerable part of that effect is due to this cause, still remains unanswered: and some will still incline to the opinion that the causes already alluded to contribute their share to the result. I know of no way in which this opinion can be disproved, but by placing the body under such circumstances, that all the assigned causes, except the contraction of the muscles, shall be eliminated. This is so easily effected, and affords so conclusive a proof, that the neglect of it is matter of surprise. The following simple experiments seem decisive of the question:—

The mean difference between standing without support, and leaning —the same position of the body being as nearly as possible preserved —amounted, in twelve experiments made upon myself, to 12 beats; being precisely the same difference which took place, at the same time, between standing and sitting. The mean of eight experiments made on other healthy males was 8 beats.

The same result followed a similar experiment in the recumbent posture. The body was first supported by two chairs, placed, the one under the head and shoulders, the other under the feet: after the pulse had been counted, a third support was put under the back. In the first case, an average of five experiments gave 80 beats; in the second, 66; being a difference of 14 beats. The greatest difference was 25; the least, 8.

The next experiment was made to ascertain the difference in the frequency of the pulse when the body was in the sitting posture; and the back first supported, and then unsupported. A mean of ten experiments, made upon myself, gave the following numbers:—Back supported, 80; unsupported, 87; being a difference of 7 beats. In this case, the pulse was, in each instance, raised above its natural frequency in a state of rest.

In the last experiment which I shall mention, the body was placed

in the sitting posture, with the legs raised, and extended at right-angles to it; and, as in the last case, the back was first unsupported, and then supported. Twenty experiments made upon myself give the following results:—Back, unsupported, 86; supported, 68; being a difference of 18 beats. The mean result of fifteen experiments of the same kind, made on healthy males, is—Back unsupported, 80; supported, 68; being a difference of 12 beats.

These experiments, though carefully made and correctly stated, are not so numerous as those already adduced; as my object in making them was, not to supply average results, which might prove practically useful, but simply to ascertain facts. In the first experiment, the difference between standing and leaning was exactly the same as between standing and sitting: in the last, the difference between the unsupported and supported positions of the body amounted, in my own case, to the difference between standing and lying, when the pulse in the erect posture is 86; and in the experiments made upon others, to little less than the effect of a change from standing to lying, when the pulse in the erect posture is 80. Now, in all these experiments, the position of the heart and of its valves, as well as that of the larger vessels of the body, remained the same: the amount of muscular contraction alone varied. Hence, then, in cases where the other causes which have been assigned are carefully excluded, the contraction of the muscles, which is necessary to support the body in certain positions, is sufficient to produce a considerable increase of frequency in the pulse; and a comparison of the amount of that increase, with the difference between standing and sitting, or standing and lying, gives the strongest possible confirmation to the opinion which has been so frequently stated. These considerations, therefore, added to those which have been already advanced, seem fully to justify the conclusion, that *the effect produced upon the pulse by change of posture is due to muscular contraction:* and if we are warranted in stating thus much, we may go yet a step further, and assert, that *muscular contraction, whether employed to change the position of the body or to maintain it in the same position, accelerates the pulse; and the effects produced by change of posture form merely a particular case of this more general law.* If this conclusion is legitimate, another step has been made towards the great object of all our scientific inquiries—the merging particular facts in general laws; which, if it have no better tendency than to render science more compact, will not be without its use.

With regard to the cause or causes of the numerous exceptions to general rules, I shall not, at present, hazard a conjecture. I entertain

no doubt, however, that they will admit of a satisfactory explanation. The practical application of the facts which have been stated is also a subject of considerable interest; and I am now collecting materials which will enable me to discuss the question, at no very distant period.

I will now bring my observations to a close, by re-stating, as briefly as possible, the several facts which have been established.

1. In healthy males of the mean age of 27 years, in a state of rest, the number of the pulse is, Standing 79, Sitting 70, and Lying 67 ; the difference between standing and sitting being 9 beats; between sitting and lying, 3 beats; and between standing and lying, 12 beats. When all exceptions to the general rule are excluded, the numbers are, Standing 81, Sitting 71, and Lying 66 ; the difference between standing and sitting being 10 beats; between sitting and lying 5 beats; and between standing and lying 15 beats. The same differences expressed fractionally, are as follow, inclusive of exceptions; $\frac{1}{9}$, $\frac{1}{20}$, $\frac{1}{6}$; exclusive of exceptions, $\frac{1}{8}$, $\frac{1}{13}$, $\frac{1}{5}$.

2. The extremes are very remote from the mean results. Thus, the greatest difference between standing and sitting is $\frac{1}{4}$, the least $\frac{1}{19}$, of the frequency standing ; the greatest difference between sitting and lying is $\frac{1}{4}$; the least $\frac{1}{80}$ of the frequency sitting : whilst between standing and lying, the difference may be somewhat less than $\frac{1}{3}$, and as little as $\frac{1}{14}$ of the frequency standing. The greatest difference observed amounts to somewhat less than $\frac{1}{3}$ of the frequency standing.

3. The exceptions are as follow:—To the general law, that the pulse is less frequent sitting than standing, there is 1 exception in 12 experiments : to the general law, that the pulse is less frequent lying than sitting, there are 3 exceptions in 10 experiments : to the general law, that the pulse is less frequent lying than standing, there is 1 exception in 14 experiments. The total number of instances in which 1 or more exceptions to general rules occurs, is 34, or somewhat more than 1 in every 3.

4. The effect produced by change of posture increases as the frequency of the pulse increases. For the rate of increase, see Table III.

5. The exceptions to the general rule are more numerous as the pulse is less frequent.

6. The effect produced upon the pulse by change of posture is due to muscular contraction.

7. Muscular contraction, whether employed to change the position of the body, or to maintain it in the same position, accelerates the pulse ; and the effects produced by change of posture form but a particular case of this more general law.

TABLE, *shewing the* EFFECT *of* CHANGE OF Po[sition]

[The mark (*) indicates t[...]

No. of Expt.	Age	Standing.	Sitting.	Lying.	Standing and Sitting.	Sitting and Lying.	Standing and Lying.	No. of Expt.	Age	Standing.	Sitting.	Lying.	Standing and Sitting.	Sitting and Lying.	Standing and Lying.
·i	20	98	72	54	26	18	44	xxvi	20	92	82	76	10	6	16
ii	23	90	65	60	25	5	30	xxvii	20	72	60	56	12	4	16
iii	23	94	72	68	22	4	26	xxviii	21	73	59	57	14	2	16
iv	25	80	60	56	20	4	24	xxix	22	80	72	66	8	6	14
v	20	84	66	60	18	6	24	xxx	26	62	53	49	9	5	14
vi	22	96	80	72	16	8	24	xxxi	25	88	78	74	10	4	14
vii	20	106	94	84	12	10	22	xxxii	27	78	68	64	10	4	14
viii	22	93	77	71	16	6	22	xxxiii	24	70	60	56	10	4	14
ix	29	76	56	54	20	2	22	xxxiv	22	53	46	40	7	6	13
x	23	119	100	98	19	2	21	xxxv	27	87	80	74	7	6	13
xi	29	86	71	65	15	6	21	xxxvi	42	84	76	72	8	4	12
xii	23	88	76	68	12	8	20	xxxvii	47	74	65	62	9	3	12
xiii	28	78	65	58	13	7	20	xxxviii	40	68	58	57	10	1	11
xiv	21	84	70	64	14	6	20	xxxix	21	86	78	76	8	2	10
xv	32	79	62	60	17	2	19	xl	26	91	84	82	7	2	9
xvi	25	86	69	68	17	1	18	xli	43	67	60	58	7	2	9
xvii	44	86	70	68	16	2	18	xlii	22	84	79	75	5	4	9
xviii	29	80	65	62	15	3	18	xliii	24	86	80	78	6	2	8
xix	24	86	74	68	12	6	18	xliv	26	62	58	56	4	2	6
xx	21	78	62	60	16	2	18	xlv	25	76	72	70	4	2	6
xxi	27	76	66	58	10	8	18	xlvi	22	56	53	52	3	1	4
xxii	45	92	80	76	12	4	16	xlvii	27	88	84	80	4	4	8
xxiii	24	80	68	64	12	4	16	xlviii	23	86	83	80	3	3	6
xxiv	26	79	69	63	10	6	16	xlix	28	72	70	68	2	2	4
xxv	25	100	86	84	14	2	16	l	34	78	67	48	11	19	30

veral Varieties which occurred.]

No. of Expt.	Age	Standing.	Sitting.	Lying.	Difference between			No. of Expt.	Age	Standing.	Sitting.	Lying.	Difference between			
					Standing and Sitting.	Sitting and Lying.	Standing and Lying.						Standing and Sitting.	Sitting and Lying.	Standing and Lying.	
li	30	104	92	75	12	17	29	lxxvi	35	86	76	76	10	0	10	
lii	31	100	89	76	11	13	24	lxxvii	40	78	68	68	10	0	10	
liii	42	68	66	48	2	18	20	lxxviii	45	86	76	76	10	0	10	
liv	42	92	90	74	2	16	18	lxxix	30	72	64	64	8	0	8	
lv	38	87	80	72	7	8	15	lxxx	23	66	60	60	6	0	6	
lvi	25	94	88	80	6	8	14	lxxxi	23	68	62	62	6	0	6	
lvii	21	76	72	64	4	8	12	lxxxii	50	55	49	49	6	0	6	
lviii	21	62	61	52	1	9	10	lxxxiii	28	70	66	66	4	0	4	
lix	28	84	80	74	4	6	10	lxxxiv	26	72	68	68	4	0	4	
lx	33	72	68	62	4	6	10	lxxxv	26	68	65	65	3	0	3	
lxi	22	87	83	78	4	5	9	lxxxvi	27	66	64	64	2	0	2	
lxii	20	55	52	48	3	4	7	lxxxvii	22	60	60	60	0	0	0	*
lxiii	22	60	58	54	2	4	6	lxxxviii	27	77	77	77	0	0	0	
lxiv	21	66	64	60	2	4	6	lxxxix	20	72	52	58	20	6	14	*
lxv	20	65	64	62	1	2	3	xc	25	82	68	70	14	2	12	
lxvi	25	69	67	64	2	3	5	xci	21	97	82	86	15	4	11	
lxvii	22	96	96	80	0	16	16	xcii	20	90	74	81	16	7	9	
lxviii	34	92	92	80	0	12	12	xciii	24	64	56	59	8	3	5	
lxix	21	60	60	58	0	2	2	xciv	23	68	60	64	8	4	4	
lx	43	98	84	84	14	0	14	xcv	22	57	51	57	6	6	0	
lxxi	27	73	60	60	13	0	13	xcvi	20	76	72	80	4	8	4	
lxxii	25	90	78	78	12	0	12	xcvii	50	52	50	54	2	4	2	
lxxiii	34	80	68	68	12	0	12	xcviii	21	64	74	70	10	4	6	*
lxxiv	23	87	75	75	12	0	12	xcix	23	69	70	78	1	8	9	
lxxv	28	84	74	74	10	0	10	c	22	58	60	62	2	2	4	

TABLE II.

Average Results of the preceding 100 Experiments.

	Age.	Standing.	Sitting.	Lying.	Difference between		
					Standing and Sitting.	Sitting and Lying.	Standing and Lying.
Exceptions included . . .	27	79	70	67	$9 = \frac{1}{9}$	$3 = \frac{1}{23}$	$12 = \frac{1}{7}$
Exceptions excluded . . .	27	81	71	66	$10 = \frac{1}{8}$	$5 = \frac{1}{14}$	$15 = \frac{1}{5}$

TABLE III.

Averages of 15 Experiments.

	51 to 70			71 to 90			91 to 100			111 to 130		
	Standing.	Sitting.	Lying.	Standing.	Sitting.	Lying.	Standing.	Sitting.	Lying.	Standing.	Sitting.	Lying.
	61	55	52	81	68	66	101	82	74	120	93	81
Differences . . .	6	3	9	13	2	15	19	8	27	27	12	39
Do., expressed fractionally	$\frac{1}{10}$	$\frac{1}{18}$	$\frac{1}{7}$	$\frac{1}{6}$	$\frac{1}{34}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{10}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{3}$

AN

EXPERIMENTAL INQUIRY*

RESPECTING THE

PROCESS OF REPARATION

AFTER

SIMPLE FRACTURE OF BONES.

BY BRANSBY B. COOPER, F.R.S.

In the series of Experiments on the progress of Repara-
tion after Simple Fracture, which I have already published in
No. IV. of Guy's Hospital Reports, the appearances presented
on each succeeding day are described; but in prosecuting the
investigation, I have found it useless to enter into the detail
at intervals so short; for after the period of the callus being
formed around the fractured extremities of the bone, the
reparative process advances much more slowly than before;
and several days are required to intervene, before any change
has occurred, worthy of particular description.

The last series ended with the description of a bone which
had been fractured eight days previously: in which it was
observed that a high degree of vascularity had taken place in
the callus, especially where it was attached to the periosteum;
which, indeed, had itself the appearance of having been
converted into cartilage, and upon which small specks of
earthy matter were deposited.

Upon the examination of the subsequent experiments, on
the ninth, tenth, and eleventh day after fracture, but little
change was found to have taken place; nor were the further
steps towards reparation sufficiently advanced to require
delineation. The fractured extremities of the bones were in
each preparation imbedded in a mass of vascular callus,
which adhered firmly, not only to the bones, but also to the
muscles, more especially at those points where the fractured

* Continued from Vol. II. p. 196.

ends of the bones would have otherwise produced a great
degree of irritation.—The cancellated texture at the fractured
extremity of the bones was, in every instance, found enclosed
by highly vascular callus, in which were found small deposi-
tions of earthy material.

The preparation of the thigh-bone of a rabbit, killed twelve
days after it had been fractured, offers, however, sufficient
signs of reparative progress to render it fitted for description
and delineation; and will therefore form the commencement
of the second series of my experiments.

Exp. 9.

(See Plate I. Fig. 1.)

This drawing exhibits the right thigh-bone of a rabbit,
which had been fractured twelve days prior to its death, the
limb having been injected with coloured size. Before com-
mencing dissection, there was but little appearance of defor-
mity; the degree of shortening being slight, from the just co-
aptation of the fractured extremities of the bone. The muscles
presented nearly their natural appearance; requiring, how-
ever, careful dissection from the surface of the callus; to
which, at some points, they not only closely adhered, but
partly partook of a cartilaginous character, particularly where
they would have been otherwise most exposed to irritation,
from irregularities of the bony surface.

The exterior surface of the callus, on its anterior and
posterior aspects, presented a smooth surface, allowing of the
ready and free motion of the flexor and extensor muscles of
the knee-joint; but laterally the callus was roughened, as if
for the firmer attachment of the abductor and adductor
muscles of the thigh. When all the soft parts were removed
from the bone, the parallel position of the two fractured
portions was so perfect, that a very slight deviation from the
natural direction of the thigh-bone could be observed, which
occurred from the lower fractured end being somewhat drawn
backwards; not sufficiently, however, to have rendered the
limb incapable of supporting its natural share of the weight
of the body. A section was next made through the whole
length of the bone; when the interior of the callus presented
a firm cartilaginous mass, completely surrounding the

fractured portions, perfectly enclosing their cancelli, and extending some distance into the medullary cavity of each portion.

In the centre of the callus between the ends of the bone, a cavity was found (which is represented in the drawing) filled with lymph, tinged with blood; which had been produced probably by some irritation leading to an inflammation, and softening down of the cartilage.

The membrane covering the exterior of the cartilage seemed to be derived from the aponeuroses of the muscles which passed over it, being also intimately connected and even continuous with the periosteum of the thigh-bone : these points of connection, however, were not in the immediate vicinity of the fracture; so that a considerable portion of denuded bone at each end extended into the callus; which seemed, in fact, to be as much derived from the bone itself as from the surrounding structures. The vessels of the two membranes frequently anastomosed ; and the vascularity of each was most conspicuous at their point of junction; each membrane, however, deriving its blood from a different source;—that of the callus from the blood-vessels of the muscles, while the periosteum was supplied from those of the bone.

In the lower fractured portion of the thigh-bone, between the callus and epiphysis, a considerable hollow was situated, lined by a highly vascular membrane, evincing the important share the bone takes in its own reparation; while the epiphysis itself maintained its perfectly natural appearance.

The progress towards reparation in this experiment is very distinct, and was evident even before any dissection had been made from the slight distortion which remained; the fractured extremities of the bone being nearly approximated by the contraction of the callus. This preparation also shews how the formation of the callus depended upon the deposition from the surrounding soft parts; from the periosteum; and, more particularly, from the bone itself; proving the activity of the osseous system in accomplishing the process of consolidation.

Exp. 10.

(See Plate I. Fig. 2.)

This figure represents the thigh-bone of a rabbit which had been fractured sixteen days prior to the animal's death: and the examination of the limb took place a few hours after. Upon dissection, a degree of deformity, usually following the experiment upon a rabbit, presented itself, and to a much greater extent than in the last instance; probably depending upon the greater degree of the obliquity of the fracture, and the more irritable temperament of the animal.

In removing the muscles, the dissection was difficult, from their very firm attachment to the osteo-cartilaginous mass; into which, indeed, they seemed themselves to be partly converted, by a deposition of cartilage between the muscular fibres; which materially altered their natural appearance, and rendered them infinitely less liable to suffer from the irritation of the fractured extremities of the bone, as well as converting them into a structure capable of maintaining that degree of rest essential to reparation.

When the muscles were removed from the femur, a very slight extent of motion could be produced between the two fractured portions; and the little motion that did exist, was evidently depending upon the elasticity of the cartilage, and not upon any attempt at the formation of a new joint; indicating a considerable degree of advancement towards bony union. The membrane covering the callus was thick and highly vascular, especially at the sides of the fracture, where numerous vessels might be seen passing in between the two bones.

Upon a section being made through the callus, the two ends of the bone were found perfectly surrounded by it, and it even entered into the openings of their cancelli, as well as filling up the space therein; being in this situation not only vascular, but studded with numerous spiculæ of earthy matter. Upon sawing through the shaft of the bone, the medullary cavity seemed enlarged, as if by the absorption of the compact structure; and the lining membrane shewed every indication of active inflammation; which did not, however, extend to the epiphysis of either portion of bone.

The compact structure of the bone towards each fractured

end was softened, as if deprived of its earthy matter by interstitial absorption; and was not only intimately connected with the surrounding callus, but presented nearly the same degree of vascularity. The direction of the more exuberant supply of callus in this preparation is well worthy of attention; as shewing how it has been deposited in such a position as to render the repaired bone, upon completion of union, better fitted to support the weight and motion of the animal.

At the first view of this drawing, there does not appear to be an equal progress of reparation to that in the preceding experiment; which depends, probably, upon the greater degree of obliquity of the fractured bone: but still, the contraction of the callus, its high state of vascularity, and the numerous depositions of earthy matter, are all indications of its advancement towards union.

———

A cat was chosen for the subject of the following experiment, to ascertain whether the consolidation would not proceed more quickly in this animal than in the rabbit; in which, progression is produced by such sudden and violent contractions of the muscles of its posterior extremities, as to be likely to interfere with the process of reparation. Nor can this variation interfere with the series of experiments; as the object is, not to ascertain the period of reunion, but merely the process by which nature perfects the cure of fracture.

Exp. 11.
(See Plate I. Fig. 3.)

A full-grown cat, the subject of this experiment, was killed twenty-one days after the right thigh-bone had been fractured; and the limb was injected with size. Upon examination, the following appearances presented themselves:—A very considerable degree of motion existed between the fractured extremities of the bone; although a great quantity of callus was thrown out, particularly on the outer side of the limb, where a projection was very evident, produced principally by the upper portion of the bone. The limb was much shortened, and considerably distorted. Upon dissecting off the muscles, nothing abnormal presented itself beyond their shortening, to accommodate themselves to the diminished

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length of the limb, and their firm adhesion to the most pro-
minent parts of the callus.   When the muscles were removed,
the periosteum of the thigh-bone, as it descended along the
shaft, towards the fracture, appeared to become more and
more vascular; and in the immediate vicinity of the injury,
to be softer and thicker, sending numerous minute vessels
into the cylinder of the bone, which itself had become
softened and perforated by many small foramina, to convey
the minute ramifications into the interior.   The cartilaginous
tumor surrounding the ends of the bone was covered by a
firmly-adhering fibrous membrane, connected with the peri-
osteum above and below the fracture, and scarcely separable
from the callus, while its external surface most intimately
adhered to the various muscles which passed over it.   From
these muscles it derived its supply of blood; the vessels of
which, probably originally only capillary, had now become
distended with injection, and could be traced through the
callus, and anastomosed frequently with the vessels of the
bone.   On dividing the cartilaginous tumor surrounding the
fractured bone, posteriorly the knife was opposed by new
osseous matter, which connected the two sides of the broken
shaft.   It was necessary to break through this portion,
to exhibit the new structure: and this is preferable to the
use of the saw, when the new bone is sufficiently soft to
permit it; as we obtain a more natural display than when the
cells are broken down and filled with the saw-dust.   The
structure between the bones being thus exposed, there might
be observed numerous small blood-vessels passing from the
external fibrous and adherent capsule, through the cartilage,
which subdivided into an infinity of minute branches, enter-
ing the new bony deposit, and communicating to it a bright
rosy tint, of a much deeper colour than that of the cartilage:
although the vessels of the latter were larger, the numerous
capillaries of the new bony deposit appeared to be the true
organs of its growth and nutrition.   There still remained in
this limb a cavity between the opposite sides of the adjacent
fractured extremities; in which, however, a portion of coagu-
lable lymph, from its colour evidently recent, and as yet un-
organized, was firmly coherent, and attached to both sides of
the cavity, shewing the manner in which the ultimate union

was to be effected. The openings made into the cylinder of both portions of the shaft were found closed by earthy or osseous particles, which appeared to have been deposited in the coagulable lymph, originally filling this cavity, to be supplied by the vessels of the medullary membrane, or internal nutrient artery of the bone.

<center>Exp. 12.</center>

<center>(See Plate II. Fig. 1.)</center>

The thigh-bone of a full-grown rabbit was fractured, and the animal killed twenty-nine days afterwards; when, upon dissection, the limb having been injected with size, the following appearances presented themselves.—It was very obvious, however, before the soft parts were removed, that the bony union was very complete, and not the slightest degree of motion could be produced, nor any other appearance of deformity, than a slight shortening of the limb. The muscles presented a natural appearance; being, however, highly injected with size, and seeming abnormally large; which depended, probably, upon their permanent contraction, to adapt themselves to the diminished length of the limb. Upon removing them from the bone, they were found to be united very firmly to the posterior and lateral aspects of the callus; but the extensors of the knee-joint moved freely over its anterior surface. In the progress of this dissection, numerous ramifications of blood-vessels of the muscles could be seen running into the membrane covering the callus; from which it appeared entirely to receive its blood, although some of them could be traced anastomosing with the vessels of the periosteum. The vascularity of this new membrane was infinitely greater than that of the old periosteum. The callus had almost entirely been converted into bone, so as to present very little further deviation from the natural thickness of the thigh-bone than what was produced by the overlapping of the two fractured extremities. The upper and anterior projecting portion was rendered perfectly smooth by the absorption of all its asperities, and presented a surface well fitted for the muscles readily to play over.

The inferior and posterior projecting extremity was rounded; but still somewhat rough for the attachment of the

flexor muscles, which were with difficulty dissected from this portion of the bone, and could only then be removed at the expense of the periosteum.   On each side of the callus, at the point of union of the two fractured extremities, apertures, nearly as defined as natural foramina, could be observed for the passage of blood-vessels.   The bone was now divided, by a fine saw, in a vertical direction, from before to behind; when it could be seen how firmly the anterior portion of the femur was united by bone to the posterior and inferior fractured portion, as well as the extent to which they overlapped each other.   This union was effected by the deposit of new osseous matter, from the surfaces of the extremities, at their point of contact, as well as by a considerable deposition from the cartilage which closed the ends of the fractured extremities; this being continuous with the surrounding callus.   The interior of the cylinder of each portion of the thigh-bone, above and below the fracture, were filled by the medulla, and the membrane was highly injected; but these hollows were not continuous with each other, but separated by a strong septum of new bone, already described as forming their union, in which no appearance of cancellated structure was yet obvious.   The newly-deposited bone was highly vascular; and its vessels seemed to be produced by the anastomoses between the arteries of the medullary membrane and the new periosteum, the latter being much more vascular than the periosteum of the old bone.

Exp. 13.
(See Plate II. Fig. 2.)

The thigh-bone of this rabbit had been broken five weeks before the animal was killed, and the limb was injected with size.   The dissection of the muscles from the callus was easily effected, particularly from its anterior and posterior surfaces; while to its lateral aspects they adhered firmly, as if naturally inserted; at which points the fibres of the muscles were separated by depositions of callus. The membrane covering the callus was highly vascular, deriving its blood principally from the vessels of the adjacent muscles, which freely anastomosed with those of the periosteum.   The thigh-bone was much expanded at the point of

union of the fractured extremities, by the addition of new bony matter; which was rendered perfectly smooth by the absorption of all its asperities upon its anterior and posterior surfaces, readily allowing the motion of the muscles; and a distinct groove might be seen behind, for the passage of an artery and nerve. Upon the membrane being detached from the surface of the osteo-cartilaginous mass, it presented a highly-injected or vascular surface, which was rendered particularly distinct by contrasting it with the old bone when deprived of its periosteum.

On making an oblique section through the whole of the callus, the bones were readily separated; their bond of union proving to be a firm cartilage, interspersed with numerous bony spiculæ, which gave way, with a grating noise, before the edge of the knife. The investing membrane of the callus greatly exceeded in thickness the true periosteum; and its blood-vessels passed through the substance of the callus, to anastomose with those of the medullary membrane: but there was no indication of cancellated structure in either fractured portion, their interior being entirely filled by new osseous matter, so that in this situation it appeared that the progress of bony union had most advanced.

Exp. 14.
(See Plate II. Fig. 3.)

A cat was again chosen for the subject of experiment; and the animal was killed six weeks after its thigh-bone had been fractured, the limb being minutely injected with size. The muscles were removed; which presented nothing abnormal in their appearance, beyond being somewhat wasted. The osteo-cartilaginous deposit, forming the bond of union of the two fractured extremities of the bone, connected them as nearly as possible parallel with each other; although the upper overlapped the lower extremity to nearly the extent of one-fifth of the natural length of the femur. The two portions were very firmly connected by the adventitious deposit; which was not, however, completely converted into bone, as was evident by the degree of elasticity, which permitted a slight motion upon the application of considerable force.

The uniting medium between the bones was irregularly

nodulated and rough on each lateral surface; but its anterior and posterior aspects were smooth, and somewhat hollowed, as if by the action of the extensor and flexor muscles of the knee-joint, as they played over these surfaces.

The periosteum was adherent to the shaft of each portion of the bone, up to the points of their union; where it seemed to cease, and a new membrane to be formed, covering the cartilaginous deposits, and performing the function of periosteum, by enclosing the newly-deposited matter, and connecting it with the surrounding tissues.

The non-identity of the two membranes was manifest, from the difference of their organization; the one covering the cartilage being much more vascular, softer, and so far separated from the femur as to be placed out of the reach of support from the vessels of the bone; while the old periosteum, although thickened and inflamed, still retained its fibrous texture, and close proximity to the osseous system.

A section was then made, with a fine saw, through the whole length of the femur, from before to behind; by which the precise extent of the newly-deposited cartilage could be appreciated, presenting a thickness equal to the section of the cylinder of the femur, being irregularly studded with depositions of bone. Both fractured extremities of the bone were found tapering, as if their external compact structure had been partly absorbed with the medullary cavity of each; and were filled with cartilage and newly-deposited bone, offering a very considerable ossific firmness, particularly at the lower extremity.

In this preparation, that part of the compact structure of the femur with which the new deposit was in contact exhibits clearly an interstitial absorption, and proves the active parts it maintains in the reparation of the injury.

Exp. 15.

(See Plate III. Fig. 1.)

The right thigh-bone of a rabbit was broken on the 5th of April, and the animal was killed on the 28th of May; making a period of seven weeks and four days after the injury had been inflicted. Upon the removal of the muscles, there was very little appearance of distortion of the bone; and their

point of union presented but an inconsiderable enlargement beyond the natural size of the femur; and the obliquity but in a very slight degree altered the direction of the femur, there being only a slight angle inwards and backwards, where the two fractured portions had been joined by the new deposit. The surface of the new osseous tumor was quite smooth, all its asperities having been removed by absorption; and on its posterior aspect a distinct groove was found lined with cartilage, in which had been lodged the flexor muscles of the leg.

Upon the application of considerable force, a slight degree of motion was perceptible between the two fractured portions; but rather as if the whole length of the bone yielded from a general softness of its compact structure, than from any imperfection in the bond of union.

A section was made of the thigh-bone, so as to pass through the centre of the junction of the two fractured portions; when, upon exposing the interior, a very considerable continuity of the cancellated structure of the two extremities was exposed, so as to give to the bone much more the appearance of the section of an uninjured femur than had ever been exhibited in any former case.

This change seemed to have been effected by the compact structure of both portions of the bone (where they had been in contact) having become absorbed, and leading necessarily to the conjunction of their interior cancellated structure; but this blending was not only obvious at the seat of re-union, but also above and below the fracture, so that there appeared but little deviation from the natural direction of the medullary canal.

The medullary membrane in the whole length of the bone was highly vascular, evincing a very energetic inflammatory action still existing.

The periosteum covering the new bone was also very vascular; and had become so perfectly continuous with the periosteum of the shaft of the bone above and below the fracture, as to render it very difficult to distinguish the old from the newly-formed membrane; more particularly so, as the adventitious formation was so contracted, as to surpass in a very slight degree the natural size of the thigh-bone.

The compact texture of the bone, throughout its whole length, was rendered so thin, as, when macerated, to permit of its being bent upon the application of a very slight force, but without its breaking. It is worthy of remark, that, although the compact and cancellated structure of the bone had undergone so great a change, the epiphysis at each extremity retained its natural appearance; proving that a different and separate function is performed by these portions of the bone. It should also be observed in this drawing, that a greater quantity of new earthy deposits had taken place in that position where, from the angular union, the bone would otherwise have been less capable of sustaining the weight of the body or resisting the action of the muscles.

Exp. 16.
(See Plate III. Fig. 2.)

The thigh-bone of the rabbit, the subject of the following description, had been broken eight weeks before the animal was destroyed; at which period it was in full vigour, having entirely recovered from the effects of the injury.

Immediately after the death of the animal, the aorta was injected with fine injection, just above its division into the iliacs; but, upon dissection, the vessels of the muscles of the thigh presented no appearance of having been filled with size, although the main trunk of the limb was distended. The muscles had quite their natural appearance; excepting the slight degree of shortening, corresponding to the position of the broken femur.

The callus resembled, in almost every particular, the appearance described in the last experiment; but permitted a greater degree of motion, however, in that direction, which tended to bring the thigh-bone towards its natural axis. A distinct groove was formed in the posterior surface of the callus, through which passed a large blood-vessel and nerve.

On a section being made through the bone, its fractured extremities were found completely closed with a dense osseous deposit; leaving still an interval between the two ends, consisting of cartilage interspersed with numerous deposits of earthy matter, and highly vascular, particularly in the immediate line of demarcation between the cartilage and new

bone, so as to give evidence of the active local circulation still continued for the further deposition of osseous matter.

The axis of the united bone was very nearly natural in its direction where the section had been made; although in appearance, before the division, it deviated considerably from the opposite thigh-bone, in consequence of the masses of newly-deposited bone at the point of junction, especially posteriorly, giving an abnormal form to the broken femur.

Exp. 17.

(See Plate III. Fig. 3.)

The thigh-bone of the rabbit, from which this drawing was made, had been fractured nine weeks previously to the animal being destroyed. Before any dissection was commenced, the limb presented great deformity, both from its extent of shortening produced by the overlapping of the two fractured extremities, as well as from the great angle they formed inwards and backwards at their point of union. Not the slightest motion whatever could be produced between the two portions. On dissecting off the muscles, they were found to adhere very firmly to the newly-formed bone, especially posteriorly, where the union of the two portions of femur was so perfect as to leave no trace of a recent separation. A deep groove extended vertically through the posterior surface of the new bone, in which were lodged the flexor muscles of the leg; and not the slightest irregularity of surface anywhere presented a source of irritation to the surrounding soft parts. In consequence of the great obliquity of the union of the two fractured portions of the femur, the articular surface for the reception of the patella was much altered in its form. The periosteum covering the new bone was thicker and more vascular than that of the shaft of the femur.

On making a section of the shaft of the bone so as to divide it vertically through the fracture, it was at once perceived that the union had been effected, partly by a deposition of earthy matter from the external surface of the bone, and partly from the medullary membrane; which, extending down to the very points of the fracture, more especially from the upper portion, not only closed the broken ends of the shaft,

but also formed the bond of union which cemented the two extremities.

On the outer side there was also found new earthy deposit; but here it was more intermixed with cartilage, a distinct line of which could be traced through the seat of injury, clearly marking the obliquity of the fracture. Some strong osseous points also passed from the outer side of one fractured portion to the other, which gave considerable additional strength to this part of the union. The shell of the upper portion of the fractured bone was very thin anteriorly; but in the opposite direction it was found proportionably thickened, so as to give great strength at the point of union. The nutrient arteries of the bone had been, in this case, very highly injected, as well as those of the periosteum; and they freely anastomosed with each other, through the thinnest part of the anterior portion of the femur.

Exp. 18.
(See Plate III. Fig. 4.)

The cat, the subject of this experiment, had its right femur fractured on the 18th of May, and was destroyed on the 28th of July; making a period of ten weeks and one day. Both lower extremities were injected with coloured size, and dissected about twelve hours after death. When the integuments had been removed from the two limbs, there was very little appearance by which the limb that had been submitted to the experiment could be distinguished, either from the position of the muscles, or from the degree of shortening of the bone; nor could the slightest motion be produced between the fractured portions of the injured femur. When the muscles had been removed, the direction of the fractured thigh-bone presented very little deformity, in consequence of the parallel position of the broken portions; but it was found one-seventh shorter than the femur on the opposite side; being but three inches in length, while the sound one was three inches and a half. This shortening was produced by the upper portion being placed in front of the lower, and extending into the new osseous deposit, so that the two portions very slightly overlapped: the medullary canal of the upper fractured extremity was perfectly closed by new

bone, which terminated in a rounded smooth surface; but
the upper end of the lower fractured portion was not closed
to the same extent. The new earthy deposit between the
two portions, and forming their bond of union, was an inch
in length, and rather more than two inches in circumference;
while the centre of the uninjured femur measured an inch.
The periosteum covering the fracture was thicker and much
more vascular than that of the rest of the bone, and was
more readily removed from the new than from the old bone.
A vertical section being made through the femur, the interior
of the bone presented the following appearances. All the
newly-formed bone proceeded from the overlapping portions
of the femur, so as to connect them firmly to each other; and
into this newly-deposited bone the upper fractured portion
extended, terminating in a firm, compact extremity; so dense
in texture, as not to admit any injection to penetrate, while
the rest of the new bone was highly vascular and spongy.
The medullary membrane of the fractured femur was in
an active state of vascularity; and its vessels could be seen
shooting through the compact shell of the old bone, into the
newly formed ossific bond of union, which was most complete
both as to firmness and extent.

On taking a retrospective view of the phenomena which
present themselves after the fracture of bone, in the order in
which they successively occur in the foregoing experiments,
the mind is naturally led to the consideration of the question,
whether each is to be regarded as the result of a process set
up by nature for the purpose of reparation, or merely as the
necessary consequence of the injury done to the surrounding
parts by the force required to produce the fracture. All
experimentalists seem too much inclined to regard the extra-
vasation of blood which necessarily follows the injury as a
step towards re-union;—and so, indeed, it may be, in part;—
but still it should be observed, that this extravasation, as well
as the inflammation which is produced by the same cause,
must be reduced, before any new action is established for
restoration.

Upon the examination of a limb twenty-four hours after

the thigh-bone has been broken, a large quantity of extrava-
sated blood is found diffused into the cellular membrane of
the muscles, filling up the spaces between the fractured ex-
tremities of the bones, and occupying the opening into the
cancellated structure of each fractured extremity.

The periosteum in the neighbourhood of the seat of fracture
is infiltrated with blood, and thickened, so that a general
extravasation of blood attended with tumefaction is all that is
to be observed, as the immediate result of the injury.   But
let us now examine what beneficial results may arise from
the presence of this coagulum, as conducive to the future
process of re-union of the bone.   It seems, at any rate, to
produce a degree of stiffness or immobility of the limb, a
condition highly essential to its restoration.   The absorption
of the serum and red particles of the clot tends to give a still
greater degree of firmness around the injured bone; whilst
the fibrin remains in a state which seems to render it capable
of becoming organized: for it will now be found firmly
adherent to the surrounding structures, with a tenacity com-
mensurate with the degree of vascularity of the tissue in
contact; although at this period no vessels can be found in
its own substance.   If a portion of this fibrin be detached
from its connection with any surrounding part, it will be
observed to present a vivid red colour, while its external or
free surface maintains a dark venous hue : this appearance is
more particularly obvious in the blood, filling up the space
between the fractured extremities of the bone; and in this
situation, too, it is more firmly adherent to the lining medul-
lary membrane, which is found highly vascular, and seems
itself to have effused the coagulum in question.

Such seem to be the immediate results of the injury; and,
as yet, but little can be fairly attributed to a reparative effort
on the part of nature.   This condition remains for a shorter
or longer period, depending upon the age and constitutional
power of the animal, as well as upon the concomitant
circumstances connected with the injury.   In the next stage,
a process of repair seems to commence; which is indicated by
an inflammatory action having led to the deposition of coagu-
lable lymph, adhering not only firmly to the periosteum, but
also to the coagulum, which has now acquired a considerable

increase of firmness, so as to produce a degree of stiffness of the limb, which maintains the bone in a state of comparative rest. The effusion of lymph proceeds, so as to fill the adjacent cellular membrane, to occupy the space between the separated fractured extremities of the bone, to thicken the periosteum, to fill up the interstices between the muscular fibres, and, in fact, at this period to present so homogeneous a surface, as to render it difficult to distinguish the various structures from each other. The quantity of lymph effused is not equal at every part, but seems to depend upon the degree of irritation produced; for at those points where the extremities of the bone come in contact with the muscles, it is sufficient completely to surround the bone, to confine it in its situation, and at the same time protect the muscle from its irritating influence; although the deposition is effected by the vessels of every adjacent tissue. About this period, the fractured extremities of the bones will be found softened, granular, and rounded, with their asperities partly removed, and firmly adhering to the surrounding lymph. This process occurs even when fragments of bone are separated; so that the detached portions are all imbedded in this newly-effused matter. Blood-vessels may next be traced, shooting through the lymph, indicating its commencing organization; and a greater degree of firmness is at the same time observable in the direction of the blood-vessels; and an apparent anastomosis is established between the nutrient blood-vessels of the bone, those of the periosteum, and of the cellular membrane surrounding the lymph. This altered character of the effusion is most remarkable in the space between the fractured bones, where the lymph puts on the appearance rather of ligamentous bands than of portions of cartilage : the whole mass, however, hardens, and forms what is termed the " callus ;" which consolidation leads to an approximation of the separated bones, guarding more perfectly against the possibility of any motion which would retard the progress of ossification. The contraction of the callus frequently continues, till it produces a perfect contact of the overlapping bones. This contraction seems to result from interstitial absorption; for a distinct cellular membrane may be observed between the muscles, forming a complete membranous

covering to the callus, which is continuous with the periosteum of the shaft of each portion of bone, to some extent beyond the seat of fracture.   Between the bones the callus now puts on all the firmness and appearance of true cartilage; and at the point of contact, or of their nearest approximation, no appearance of periosteum can be discovered; the union being apparently produced by the compact structures of the bones themselves; each fractured extremity overlapping, however, as if the medium of connection were partly growing from the interior of the bone.

There is reason to believe that the cartilage thus formed differs in its nature from that deposited by the surrounding cellular membrane: first, because it is more permanent, and becomes ultimately converted into bone; whereas the outer layers, which are secreted by the cellular membrane, become absorbed: and secondly, because it has been proved, by experiment, that if an animal be fed with madder during the progress of ossific reparation, the former becomes stained with the colouring matter of this vegetable, while the latter remains untinged.

The next step towards the process of re-union is the conversion of this interosseous cartilage into bone; which takes place in the following manner.   The white opacity (the physical property of cartilage) is converted into an appearance of vascularity, in several red spots or disks, which seem irregularly but simultaneously formed: these deposit specks of ossific matter; and go on until the whole is transformed into bone; when, if a longitudinal section be made through the shaft, it will be seen that the compact structure of both extremities has been changed to a cancellated one, and has thus rendered the newly-deposited osseous matter continuous with the cancellated structure of each portion of the fractured bone; so that the medium of union is now enclosed in one continuous investing membrane, to an extent depending upon the degree of parallelism of the two portions: at present, however, no new medullary cavity is formed.   This union resembles very much the process that is followed in the reparation of soft parts: in the one case, the newly-formed bone continues to grow from each fractured portion until they coalesce; and in the other, the vessels of

the granulations of soft parts inosculate from various points, and fill up the wound.

This constitutes the union of a fracture: but before it is actually perfected, it will always be found that the extreme edges of the new bone, on those sides which are approaching each other, exhibit a vascular line, consisting of numerous vessels capable of being filled by injection more readily here than at any other part; shewing that a further process has yet to be carried through.

When union is first established, the bone, on a section being made, exhibits a spongy or reticular texture, which interrupts the continuity of the medullary cavity; so that there is a considerably larger deposit than is found to exist at a later period; and a further process is still required to restore the new bone to the condition of the original structure. This action is slow in its progress; and it is not till the end of several weeks, or even months, that absorption takes the place of secretion, or, at least, becomes the more energetic of the two. The bone then grows less vascular; and a modelling process is established, by which the whole size of the adventitious deposit becomes reduced. The asperities of the bone are rounded off; grooves are formed for the passage of tendons, blood-vessels, and nerves; and, finally, the medullary cavity is restored, when the reparation may be considered as complete.

It is not to be supposed that the appearances described as presenting themselves in these experiments will be found invariably to observe the order of succession here detailed; for the progressive steps followed by nature, in the process of reparation, are as various as the circumstances connected with the injury: thus, the fact, of whether the fracture be simple or compound—the kind of bone injured—the direction of the fractured extremities—the extent of injury to the adjacent soft parts—the degree of rest maintained—as well as the age and constitution of the subject, are circumstances which tend to modify the subsequent actions, so as to adapt them to the peculiar conditions of each particular case. No general rules can, therefore, be laid down, as to the detail of the results which follow the solution of continuity of bone.

In compound fractures, we generally find the process of

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union established very differently from what is observed in
simple fracture; for as the bone derives its blood from the
vessels of the surrounding soft parts, their lesion, and separa-
tion from it, deprives it of that source of nourishment; and it
either exfoliates; or, if it be preserved, suppuration is likely
to occur; and the only means of union left, is through the
medium of granulation; unless, indeed, the injury to the soft
parts be so slight, that they rapidly unite, and place the bone
in the same condition as in simple fracture.   The blood, also,
which is extravasated in compound fracture may, from being
exposed by the wound, be rendered incapable of performing
its part in the reparative process;—an hypothesis which was
suggested by John Hunter, who considered that under these
circumstances the blood lost its vitality, and that the " stimulus
of imperfection" obliged the parts to set up a new action.

There are, however, other circumstances, besides the lace-
ration of soft parts, which may retard ossific union, or even
entirely prevent its occurrence: a peculiarity in the constitu-
tion of the subject frequently leads to such deviations from
the natural process of ossific depositions.   The permanent
separation of the fractured extremities of the injured bone—
the part of the bone broken—the interposition of some soft
structure—and the absence of a continued condition of rest,
will each cause a great delay, if not the prevention of union.

To sum up in a few words the result of the foregoing in-
vestigation, as far as it has been carried, I should say, that
the effects of a simple fracture of bone are—first, the effusion
of a greater or less quantity of blood; next, the absorption
of its serum and red particles: inflammation of the bone, and
all the surrounding tissues, next takes place : this leads to a
deposition of lymph, which soon becomes hardened into car-
tilages; which, if not different in character, seem, at least, to
perform two distinct offices:—that secreted by the cellular
membrane of the surrounding soft structures produces, by
its hardness and contraction, an approximation or even con-
tact of the fractured portions; and this, proving a fresh source
of excitement to the cartilage secreted by the vessels of the
bone, leads to its ossification; whilst that thrown out by the
soft parts, is, in the end, either absorbed, or converted into a

structure the same with that which effused it; shewing that the vessels of each part are capable of appropriating their blood to the reproduction of the particular structure from which it was derived.

It may be well to observe, that, in the prosecution of these experiments, no mechanical means were employed, either to produce or maintain a coaptation of the fractured extremities of the bone; but they were left entirely to the action of the muscles, so that a considerable degree of obliquity or shortening almost invariably occurred. In two or three experiments, the results of which I have not published, I did apply splints for the purpose of preventing motion, so as to enable me to judge of the comparative quickness of re-union; but in each case the animal died, as if the splints had given rise to increased irritation. A very similar result to this I have seen in the fractures of bones of young children; when, by merely placing the fractured limb on a pillow for support, without any application whatever, the union has been more quickly performed, attended with less constitutional irritation, and followed by less deformity, than when these more complicated mechanical aids were used.

PLATE I.

Fig. 1. (Twelfth Day.)—This plate exhibits the effusion of a great quantity of cartilage, particularly from the fractured extremities of the bone, which are brought more than usually in a direct line towards each other. Specks of earthy matter may be seen deposited in the centre of the cartilage, more or less surrounded by numerous small blood-vessels. A point in the upper fractured half shews the appearance of a small detached portion of bone undergoing a change, about either to be absorbed, or, if not entirely deprived of its vascularity, to become a nucleus for further ossific deposition. A softening down of the centre of the cartilage may also be observed, as well as a highly vascular hollow in the lower extremity of the bone, while the epiphesis is seen unaltered.

Fig. 2. (Sixteenth Day.)—This diagram represents a very great displacement of the fractured extremities of the bone, as well as a very high degree of vascular action in the medullary membrane, as if consequent on the irritation produced by the deformity: hence, probably, the more energetic deposition which has taken place upon the fractured extremities of the bone. The conversion of the periosteum into cartilage, and its connection with the deposit closing the end of the medullary canal of each fractured portion of bone, is very obvious. The altered form and condition of the compact structure of each fractured end, presenting a vascularity nearly equal to that of the effused cartilage, is, in this drawing, very distinct.

Fig. 3. (Twenty-first Day.)—The thigh-bone of a cat represented in this drawing, having been minutely injected, exhibits a very high degree of vascularity of the surrounding cartilage; evincing the preparation for more perfect consolidation of the fracture by a yet further deposition of earthly materials. It may also be readily observed, in this section through the callus, how its blood-vessels seem to be derived from the interior of the bone, the cavity between the two fractured extremities having yet to be filled up by earthy deposit.

Plate 1

Fig 1

Fig 2

Fig 3

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PLATE II.

Fig. 1. (Fourth Week.)—The subject from which this thigh-bone was drawn was a young vigorous rabbit; and the great advancement towards bony union is particularly obvious, depending, probably, upon the energetic constitutional power of the animal. The medullary membrane is intensely vascular; and the ramifications of the nutrient artery may be traced supplying the new osseous structure, shewing how important a part this membrane performs in the deposition of osseous matter, if it be not actually the sole agent in the ultimate consolidation of a fractured bone.

Fig. 2. (Fifth Week.)—A comparative view of this drawing with the last sufficiently shews a less advancement towards reparation than in the former experiment, depending, probably, upon the injury the animal sustained by the violence used in producing the fracture. It is to be observed, however, that a very considerable deposition of cartilage has taken place from the fractured extremities, in which are interspersed numerous bony spiculæ. The membrane covering the callus greatly exceeds in thickness the true periosteum, and its vessels freely anastomose with those of the medullary membrane. It is to be observed, in this figure, that the medullary canal, particularly of the upper fractured portion, is closed by a new osseous deposit; proving, that in this situation the progress of bony union had most advanced.

Fig. 3. (Sixth Week.)—Represents the thigh-bone of a cat, in which it may be observed that there is but little obliquity in the direction of the thigh-bone, although the two extremities overlap to a considerable extent. The vascularity of the connecting medium is evidently derived from the medullary membrane of each portion of bone, especially from the lower. The membrane covering the new cartilaginous deposit is very vascular, and softer than the periosteum of the femur, which still retains its natural fibrous texture, and proves the non-identity of the two membranes. The extremity of each fractured portion is represented closed by cartilage and newly-deposited bone of considerable firmness; and the compact structure of the femur, in contact with the newly-deposited cartilage, clearly exhibits an interstitial absorption, beautifully illustrating the active part it is now capable of maintaining in the reparation of the injury.

Plate 11

Fig 1.

Fig 2

Fig 3
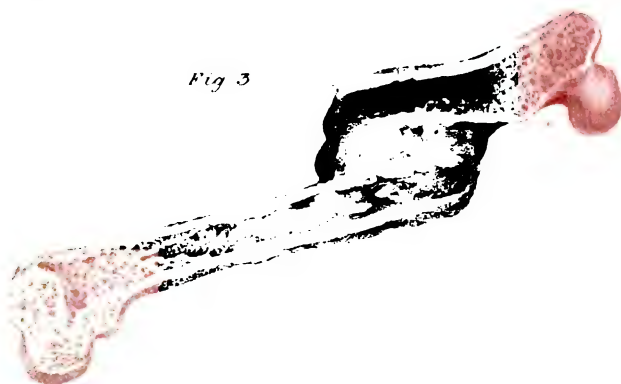
PLATE III.

Fig. 1. (Seventh Week.)—The drawing of this preparation exhibits a perfect bony consolidation, although still prior to the restoration of its medullary cavity. The newly-deposited osseous medium may be observed to be, externally, of a compact structure ; while, internally, it still retains a spongy and highly-vascular appearance. No vestige of temporary cartilage remains : and in the dissection of this preparation, all the structures surrounding the bone were found restored to their natural appearance; and even the muscles were attached by a natural tendinous insertion into the new bone.

Fig. 2. (Eighth Week.)—It is clearly shewn, by this drawing, that bony reparation had not advanced so far in this as in the last case ; but, interposed between the fractured extremities of the bone, may still be observed a limit of cartilage. It is to be remarked, however, that a line of active vascularity is present at the ultimate extremity of each bony deposit, which, there can be no doubt, would have procured, at a later period, firm osseous union. The high degree of inflammation of the medullary membrane also indicates the presence of active reparation.

Fig. 3. (Ninth Week.)—This drawing was made from the thigh-bone, when it had been allowed to become partly dry, which had somewhat altered its natural appearance. It shews, however, a bony growth proceeding from each extremity of the fracture, and uniting intermediately with a comminuted portion of the femur. This fragment has evidently retained its vitality through the medium of the vessels of the periosteum, proving how capable they are of maintaining the existence of bone, although they are incapable of reforming that structure. The outer side of the shaft of the upper fractured portion presents a large bony deposit, the vessels of which are freely inosculating with those of the intermediate fragment, in a like manner as the vessels of granulations of soft parts produce reunion ; and thus firm reparation in this case would have been finally accomplished.

Fig. 4. (Tenth Week.)—This drawing represents the thigh-bone of a cat, in which a very firm osseous union is perfectly established ; and it may be observed how the newly-formed bone has proceeded entirely from the overlapping portions, the compact structure of which, at the point of contact, has been removed by interstitial absorption, and its place occupied by newly-deposited bone. The upper fractured portion is seen extending into the new bone, and terminating in a firm, pointed, compact extremity, so dense in texture as not to admit any colouring matter to penetrate, although the bone was minutely injected. Not the slightest motion could be produced between the two portions, upon the application of any force.
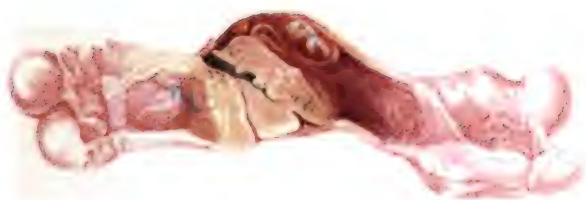
Plate III

Fig 1

Fig 2

Fig 3

Fig 4
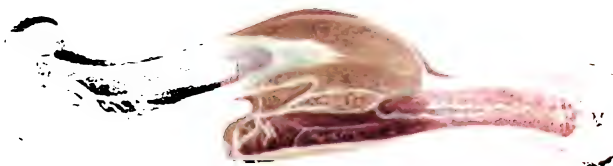
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HÆMORRHAGE

FROM THE

UNIMPREGNATED UTERUS,

ASSOCIATED WITH TUMORS OF VARYING DEGREES
OF INDURATION AND MALIGNANCY.

BY S. ASHWELL, M.D.

THE Cases subjoined to this paper deserve attention; because
they seem to establish a rather novel fact; viz, that hard
or fibrous tumors of the uterus, by many pathologists not
regarded as malignant, and by myself viewed as occupying
the lowest place in the scale of malignancy, may occasio-
nally give rise to frequent, excessive, and fatal hæmorrhage.
Other growths of more decided malignancy are, of course,
included in this statement. I am aware that this is not
an entirely new fact; for several writers allude to it; but
the observations in this essay will probably establish more
correct and precise views of the situation of these growths,
and the source of the hæmorrhage.

I regret that the treatment to be pursued is not more cer-
tainly beneficial; but, doubtless, an efficient plan of manage-
ment is more likely to result from a correct than from a
partial and erroneous pathology. The following points are
important, in reference to these uterine tumors:—

1st—They commence in the parenchyma of the organ,
or, in other words, in the substance included between its
peritoneal and mucous coverings, in closer proximity to the
mucous than to the peritoneal coat. Hard or fibrous tumors
are more commonly deeply imbedded in the substance of the
organ, and in closer proximity with its peritoneal covering;
which, when they grow externally, their most common mode
of increase, continues to invest them, however considerable
their bulk. Hence they so rarely bleed.

2dly—When these tumors produce the hæmorrhage now described, they grow internally; not imbedding themselves in the walls of the uterus, and advancing towards its external or peritoneal coat, but, by their increase in size, distending the uterine cavity; and not only stretching and irritating the mucous membrane (thereby altering its condition and deranging its functions, and especially augmenting the quantity of the catamenial secretion), but also giving rise to morbid growth of this tissue.

3dly—It is observed, when these tumors can be touched during life, that they are sensitive and painful, unlike polypi : and after death they are found to possess, either a laminated structure, with the hardness and the white lines indicative of a fibrous tumor; or, very occasionally being removed altogether from morbid growths of this class, they may have the stony hardness of real schirrus, or the heterologue structure indicative of decided and undeniable malignancy. It is rare to find these hard and fibrous tumors thus encroaching on the uterine cavity. In Guy's Museum there are many preparations illustrative of organic uterine disease. In thirty examples of hard fibrous tumors, there are only three, at the most four, where the growth is so placed; while there are twenty-six examples of such tumors imbedded in the various parts of the sides or walls of the organ. Thus it may, I think, be assumed, from the data now adduced, as well as from the general descriptions of these tumors, that the location of them now mentioned is exceedingly unusual; and, if I am right in my subsequent opinions, hæmorrhage from such growths will, of necessity, also be unusual. Cruveilhier and Dupuytren have probably been misunderstood by those who suppose that they regarded such an event as frequent. Certainly, if this be their conviction, it is opposed to the opinions of most pathologists.

Discharges of blood therefore from the uterus, continuing longer than the common losses connected with catamenial derangements, may arise, not alone from an inflammatory or congested condition of the viscus itself, independently of organic change of more than ordinary severity and protraction, from polypi, or from growths more decidedly vascular and malignant, but from hard or fibrous tumors. It is well

known how rarely these growths ulcerate, excepting when they occupy the mouth or neck of the uterus; and it is still more uncommon for them, when imbedded in any part of the walls, to bleed: although I am certainly aware, that, in any situation, the processes of unhealthy softening, or degeneration, and purulent' secretion, with hæmorrhage, may occur. But it is a fact recently established, that these more or less hard, and occasionally malignant growths, so different in many particulars from the genuine uterine polypi, may, by having commenced, in the first instance, just behind the mucous membrane, induce morbid distention and growth of this tissue, and, by congestion and inflammation, give rise to bleedings of a continued, alarming, and fatal character: and further, after death, that this same mucous membrane may be discovered entirely free from ulceration, or even abrasion: thus tending to confirm an opinion—which, I confess, I entertain—that the bleeding is principally, if not entirely, furnished by the tissue covering the surface of the tumor, rather than by the tumor itself.

The peculiarity of these examples consists in the occurrence of the bleeding prior to ulceration. So that we must always bear in mind, in hæmorrhage from the unimpregnated uterus of unusual frequency, resisting the most judicious and persevering treatment, that there may be a tumor of the kind now described, distending the cavity, and out of the reach of the finger, maintaining so congested and inflammatory a condition of the mucous membrane, as almost to render these bleedings necessary for its partial relief.

The statistical facts already adduced lead to the belief, that these are, happily, singular cases; yet it is valuable to know, that such a cause really exists; as it may lead to greater diligence in the use of early and perhaps antiphlogistic remedial measures.

It has of late been assumed, that there is much similarity between hard and fibrous tumors and uterine polypi; and, on distinguished authority, it has been affirmed, " that they not unfrequently become uterine polypi, simply by descent, and the consequent formation of a stalk." That there are points of similarity between the two diseases, although these

have probably been overrated, I do not question; but that a genuine hard or fibrous tumor ever becomes a pediculated polypus I can scarcely believe. A specimen of such a change, Guy's Museum does not supply.—That one of these hard fibrous tumors may very rarely find its way into the uterine cavity, is allowed, because the statistics of the disease prove it; and that prior to the patient's life or her powers being destroyed by the bleedings which, in this situation, the tumor may occasion, the growth may, as a *most unusual* occurrence, descend to the lowest part of the uterine cavity, distend and pass through its cervix, and ultimately find its way into the vagina, may also be conceded; but it will be a hard or fibrous tumor still; although its altered situation, and the bleedings attendant upon it, may justify and even demand its removal by the same means as in polypus.

In *structure*, with some few exceptions; in *sensibility*, both in the growth and the surrounding parts; and in *vascularity*, as well as in *many other particulars;* there is a marked difference between the hard or fibrous tumors of the cavity now described, and polypus.

An inspection of the preparations in the Museum cannot fail to demonstrate how much more distinct, generally, in the tumor, than in the polypus, is the induration of texture; and certainly the white membranous lines are much more defined and striking in the former than in the polypus. Thus, while it is somewhat rare, except in old, large, and condensed polypi, to find this indurated and linear structure; a genuine, hard, or fibrous tumor, except when breaking down, is never without it.

In the number of the growths there is decided dissimilarity: it is common to meet with many hard tumors in the same uterus, while it is very rare to find more than one polypus.

In the method of growth there is a conspicuous distinction. The polypus, probably because it is not malignant, does not affect the organization of surrounding parts; the muscular walls of the uterus being rarely thickened, however large may be the polypns. The hard tumor, on the contrary, may, and often does, convert, by degrees, the uterus in its vicinity into its own diseased structure.

The internal tissue of many polypi is spongy and cellular,

and copiously permeable by blood—a circumstance never appertaining to the hard or fibrous tumor. I was much struck, a few days ago, by a preparation in Bartholomew's Museum; where a hard tumor, imbedded in the walls, had received no injection, although the vessels in every other part of the uterus were beautifully filled—a circumstance lending something more than probability to the opinion I have just now expressed, that the hæmorrhage, in these instances, is furnished by the membrane covering the tumor, and not by the growth itself; while in the polypus probably, with very few exceptions, the bleeding occurs from the vessels in its structure; as is satisfactorily proved by its texture, and by the difficulty of getting any mercury, or other injection retained in its vessels, however carefully it may be thrown in. In the polypus injected by Mr. Sibson and myself, the mercury quickly escaped through the orifices of the vessels opening on its surface.—Sir Charles Clarke affirms, that if coloured injection be thrown into the vessels of the uterus so as to make the substance of the uterus quite red, none of it passes to the tumor of fleshy or hard tubercle.

The want of sensibility is an almost invariable condition of true polypus; while the hard or fibrous tumor is never entirely bereft of sensation.

Pregnancy may and often does occur in connection with hard or fibrous tumors; rarely, if ever, when there is polypus, except where the growth arises from the cervix or os. There are, so far as I know, very few such pregnancies on record.

Other diagnostic differences might be stated; but enough probably has been adduced to shew how very dissimilar the two diseases really are.

In the treatment, and its results, there are distinctions worthy of notice.

There is no remedy for polypus, but removal. Medicine is of no avail; and astringent injections are entirely useless. Nor am I aware that a polypus was ever spontaneously cured by absorption.

A hard or fibrous tumor has once, in my own practice, disappeared without the use of any medicine: and Sir Charles Clarke mentions a similar case, "where the tumor, as big as a child's head, could be felt through the parietes of the

abdomen, just above the pubes: upon its surface could be felt two smaller tumors; one, the size of a man's fist; and the other twice this size." The patient had laboured for some time under a very profuse discharge of blood from the vagina. A variety of means were employed for the relief of this case, for two years. Upon examining the abdomen at the end of this period, the tumors could not be discovered; and after death, the uterus was found as large as that of a woman at the end of the fifth month of pregnancy. Upon the anterior part of it, near the fundus, were found two small tumors, as large as peas; which were probably the same tumors before felt, of the size above mentioned; as there was no other vestige of them. These tumors were of a hard and resisting nature; and were lying between the muscular part of the uterus and the peritoneum covering it. Mr. Carmichael, too, maintains, that schirrus occasionally admits of cure by resolution.

The ligature can scarcely be expected to produce equally satisfactory results in both diseases. The sensibility of the hard tumor, and the probability there is that a portion of the uterine structure shall be included within its grasp, will induce less favourable anticipations of decided benefit from its use. The hæmorrhage is almost invariably and permanently restrained, in polypus, by the application of the ligature; but the implication of other portions of mucous membrane than the part of it covering the hard tumor, may still maintain continued, although diminished, loss of blood.

The treatment of these cases is far from satisfactory: palliation, in most, is all which can be expected: still, the certainty in some instances, and the great probability in others, that the hæmorrhage depends on these growths will lead to more careful and protracted management. Entire abstinence from sexual intercourse—as well to avoid the certain and great danger of pregnancy, as the great yet lesser evil of excitement—must be rigidly enforced. A patient known to be thus affected, ought for years to practise such a degree of self-denial. The recumbent position, and modified but continued antiphlogistic measures, will often be demanded; and the diet, although nutritious, should never be generous and stimulating. A practitioner in these maladies will be cau-

tions how he employs the secale, as an injection, or as an internal remedy. In my hands, it has appeared to stimulate the mucous membrane, and to increase the hæmorrhage. Narcotics, especially in the form of suppositories, have been beneficial; and the poppy and conium injections into the vagina, used cold, have appeared to restrain the bleeding. An aperient, and occasionally a purged condition of the bowels, has had a similar effect. After repeated and extensive hæmorrhage, these and other measures must be strictly pursued: nor will a disease of this nature allow the sufferer to indulge in much physical or mental exertion.

Life, in most instances, where the disease is early discovered or suspected, may be prolonged; and perhaps with a good measure of quiet and passive enjoyment, if the plan now prescribed be sedulously pursued; but on no other terms. It is possible that the tumor may temporarily cease to grow, and that the investing membrane for such period may not be the subject of repeated congestion and inflammation. Such appears to have been the result in Case, No. 1. More commonly, however, palliation and partial exemption from the bleeding is the extent of the benefit obtained.

How far iodine, aided by mild antiphlogistic treatment, may accomplish a suspension of the diseased action, I do not know; but I am favourable to its employment; nor can I think it impossible that this same agent may induce absorption.

Case 1.

(WITH A PLATE.)

Several years ago I attended Mrs. ——, for profuse menstruation; which was invariably followed, after a few days, by discharges of blood—a fact satisfactorily proved by the coagulation of the fluid.

In 1832, when Mrs. —— first came under my care, she was 39 years of age, and had borne five children, four of whom were living and healthy. The usual treatment was adopted — the recumbent posture, the local application of cold, refrigerants, opium and the acetate of lead, and a mild yet nutritious diet. The secale cornutum was occa-

sionally used; but disadvantageously, as the uterine pain and the hæmorrhage were always increased by it. Several times the bleeding was so considerable, as to require plugging of the vagina.

In 1834, 5, and 6, she was not often under my management, the menstruation and the hæmorrhage being rarely excessive. In January 1837 I examined the uterus internally, and distinctly ascertained the patulous condition of the os, and the existence of a tumor in the uterine cavity. A year and a half before, I had found the os healthy; and although, by balancing the uterus, I was sensible of its increase in bulk, I could not then make out any distinct growth. It was now sufficiently evident how large the organ had become, as I could distinctly feel it above the pelvic brim; and on partially introducing my hand into the vagina, I could, by my forefinger, touch the tumor.

I remarked that the growth was smooth and broad on its surface, not very hard; that it was painful on touch; and that it was not pediculated. This examination was not repeated; as she complained much of the pain and uneasiness it produced, and it was also followed by alarming hæmorrhage.

The remedies already mentioned were again resorted to: and, at the suggestion of another physician, the secale was repeated; but it produced severe spasmodic pain, and a return of the bleeding.

During the summer of 1837, I was informed she had frequent recurrence of the hæmorrhage; and there was always more or less uterine pain and uneasiness. On one occasion I was particularly struck with her altered appearance; the pallor of surface, and general anemia, being extreme.

Late in September 1837, I was hastily summoned, and found her nearly dead. Brandy, and plugging the vagina, stayed the fatal result for two days; but at the expiration of that period, after vomiting for some hours every thing which was swallowed, she sunk.

The drawing of the uterus will clearly illustrate the account of the post-mortem examination.

By Mr. Henry Oldham, *twenty-five hours after death.*

The body was but little wasted, the mammæ alone appearing shrunk. The abdomen only was permitted to be inspected. A layer of fat, about half-an-inch in thickness, covered the abdominal muscles, which appeared paler than natural. The liver was flabby and pale. The gall-bladder contained three gall-stones, with some inspissated bile; and its tunics were thickened.

The stomach, intestines and liver were pale and exsanguine.

The uterus was discovered nearly filling the pelvic cavity, projecting about an inch above the brim, and enlarged to about its size under a three-months' gestation. Its surface was not uneven; and the peritoneum covering it, retained its natural appearance. The uterus, with its appendages, were removed.

On making a section of the anterior wall of the uterus to expose its cavity, the paries on the right side appeared considerably hypertrophied, gradually thinning as it approached the fundus. The progress of the section was obstructed, about the entrance of the right Fallopian tube, by an oval body about the size of an orange, developed in the substance of the uterus; carrying the mucous membrane before it, filling and distending the cavity of the uterus, and closely embraced by the uterine parietes. On the left side, another tumor, about the same size, was seen; which projected laterally outwards, increasing the bulk of the uterus in that direction. It also served to distend the cavity of the uterus, projecting inwards, so as nearly to touch the apex of the former tumor;—the mucous lining, however, passing up between them; leaving a passage, as it seemed, to the left Fallopian tube.

The cavity of the uterus, by these tumors, was made very irregular and extensive; and the mucous lining, being reflected from one tumor to the other, covered a large space. This last was vascular throughout; but over the surface of the tumor growing from the fundus, it appeared particularly red, and a web of delicate vessels was detached from this part. A recently-formed coagulum, too, was seen at its apex.

The os uteri was dilated and smooth. The cervix was

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enlarged; its structure more than usually apparent; and several small vesicles were seen on it.

The ovaries appeared preternaturally full. In the right were found two cysts, large enough to enclose a common nut, filled with pellucid fluid. The left contained a cyst about the same size.

The larger and more vascular tumor was laid open, and examined. Before it was divided, it felt elastic, appearing about the consistence of steatoma. When inspected, it shewed distinctly the cystiform character; one cyst being particularly observable. This contained a yellow substance, of the colour and consistence of fat, which was but feebly adherent to the containing cyst.

CASE 2.

March 25, 1830.—Mrs. H., aged 38, is the mother of five children; the last born four years since. She lives in a confined, unhealthy court, in Spitalfields: her aspect is cachectic; and emaciation has been going on for some time. She states, that for the last two years she has menstruated profusely, and has had large discharges in the intervals. These latter always coagulating.

She was ordered to use the zinc and alum injection; to take infusion of roses, with acid and nitre; to continue in the recumbent posture; and to abstain from sexual intercourse.

June 25.—Has still profuse bleedings occasionally: employs the remedies carefully—digitalis, nitre, superacetate of lead, and occasional tonics. The latter, and the astringent injections, increase the pain and hæmorrhage.

The recumbent posture, cold, mild diet, and sexual abstinence, diminish the discharge.

July 1.—Bleeding has been excessive. On examining, I find the lower anterior part of the uterus greatly enlarged; the os widely open, easily admitting the forefinger; and a tumor, round, hard, and painful to the touch, may be distinctly perceived. The urine and fæces are difficultly passed. As pain and hæmorrhage were produced by this investigation, it was not repeated.

Twice, between this and July 25, the vagina was plugged. On this latter day, after large bleeding, she died.

The body generally, and especially the abdomen, was

emaciated; and a large and hard uterus could be distinctly felt above the pubes.

The walls of this organ being divided, a hard, scirrhous tumor, about the bulk of a very large orange, was found imbedded in the walls, and encroaching on the cavity. There was a thickened and highly vascular covering of the mucous membrane over the growth internally; nor was there any of the muscular tissue between the tumor and its mucous investment.

There were in other parts several smaller scirrhous growths; and the viscus was nearly as large as at the fifth month.

Case 3.

For this interesting case I am indebted to my friend Dr. Marshall Hall. It furnishes another example of pregnancy complicated with hard or scirrhous tumors of the uterus; occurring, too, at rather a late period of life. It is also worthy of remark, that, after parturition, the tumors inflamed; and one of them suppurated, thus leading to a fatal issue. These facts I have especially noticed in a former paper. There can be little, if any doubt, that the hæmorrhage in this instance was dependent on the diseased structures. Dr. Hall " is decidedly of opinion, from what he has observed, that tumors thus imbedded in the structure of the uterus excite hæmorrhage, and especially in the subjoined case."

" Mrs. T. C——, aged about 43 or 44, after having been subject to profuse menorrhagia, for twelve years of unfruitful marriage, at length became pregnant.

" During the course of her pregnancy, tumors were distinctly felt in several parts of the parietes of the distended uterus; and one was so superficial, that a medical gentleman mistook it for hernia.

" Parturition was pretty well accomplished; but the tumors inflamed, puerperal peritonitis occurred, and the patient died.

" On a post-mortem examination, several tumors were found inflamed, and one of them suppurated.—The uterus was only partially contracted."

CASE 4.

The following particulars were furnished by my friend Mr. Lever, with whom I saw the patient during life. An inspection after death would, I doubt not, have corroborated the opinion we expressed, that the hæmorrhage was dependent on the uterine tumor.

" Mrs. A. D——, aged 54, residing near Finsbury Market, was married at 23, and is the mother of only one child; never having had a miscarriage. Three years since, her menstrual periods became prolonged; being always attended by large discharges of coagula, and constant severe pain in the uterine region. For two years, these symptoms were entirely disregarded; but a twelvemonth prior to this time (1834) she employed astringent injections, and astringent medicines were given. For six months she had but slight menorrhagic losses, when alarming uterine hæmorrhage again occurred.—Under the advice of another practitioner, who told her friends that she had malignant tumor of the uterus, she employed astringents and tonics, deriving some relief. The secale cornutum was used; but greater pain and more excessive bleeding invariably succeeded its exhibition. Mr. Lever saw her soon afterwards, and quickly recognised the results of excessive hæmorrhage. On examining internally, the os was soft, and patulous: anteriorly, the neck was shortened; and through it could be felt something large and hard, occupying the uterine cavity. That it did not grow from the cervix was evident, as this latter part could be freely moved upon the tumor.—Dr. Ashwell also examined and confirmed the above statement.

" In a few more weeks, a large bleeding occurred, from which she never rallied. (No examination could be obtained.)"

CASE 5.

" In May 1837, I visited Mrs. ——, aged 41; a patient of Mr. Dodd, in Wilderness Row. She had never borne children, although she had been long married. She had lost much blood from the uterus; not only at the catamenial periods, but at other times: and she was now confined entirely to bed. Her face—indeed her whole surface—was pallid, and her strength was seriously impaired. She suffered much uterine pain, and frequently took opium to procure sleep.

On examining, I found the os patulous, and the cervix enlarged and œdematous. I could distinctly feel, and touch, a large growth occupying the lower part of the uterine cavity. At first, I thought it might be polypus; but on carrrying my hand partially into the vagina, my finger passed over a large tumor, situated as above, with a broad, smooth surface, and evidently not pediculated. Pressure produced pain; and a probe gently pushed against the growth, made her cry out. A good deal of blood, which coagulated firmly, was lost after this investigation. Astringent injections into the vagina and rectum, the recumbent posture, abstinence from sexual intercourse, and a mild but nutritious diet, with the vegetable tonics, were enjoined. All idea of any operation was abandoned.

It need not be observed in how many particulars this disease differed from uterine polypus.

DESCRIPTION OF PLATE.

A The smaller tumor, slightly indented on its surface by the pressure of the more prominent and vascular tumor *B*.

B The larger and vascular tumor; the web of vessels being distinctly shewn.

C The cut edges of the uterus.

B

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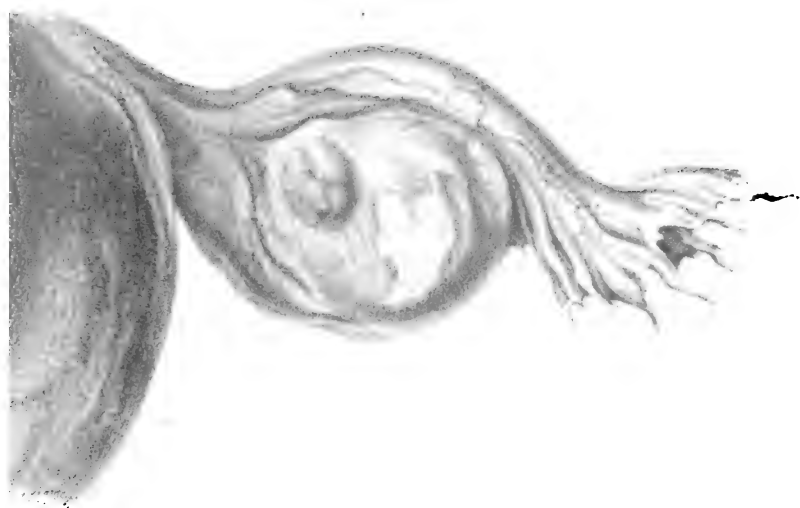
REPORTS

OF

OBSTETRIC CASES

OCCURRING

IN PETERSHAM WARD,

UNDER THE CARE OF

S. ASHWELL, M.D.

SUMMARY OF CASES OF FEMALE SEXUAL DISEASE RECEIVED INTO
PETERSHAM WARD, FROM DEC. 1836, TO OCT. 1837.*

Abortio	1	Menorrhagia	2
Amenorrhœa	7	Procidentia Uteri	4
. . . . . . cum Epilepsiâ	1	Prolapsus Uteri	3
. . . . Hemiplegiâ	1	. . . . . . Vesicæ	1
Carcinoma Uteri	10	Puerperal Mania	1
. . . . . . Vaginæ	1	Retroversio Uteri	1
Chlorosis	7	Tumor Abdominis	1
Engorgement of the Uterus	1	. . . . Meatûs Urinarii	4
Hydrops Ovarii	5	. . . . Ovarii	2
Hysteria	1	. . . . Uteri	9
Indurat. Oris Cervicisque Uteri,	2	Vesico-Vaginal Fistula	2
Inflammatio Mammæ	1	Vicarious Menstruation	2
Inflam. Oris Cervicisque Uteri,	6		
Inflammatio Vaginæ	1	Total	82
Leucorrhœa	5		

Abortio.—This case of abortion was caused by the patient receiving a violent kick from her husband. She came into the hospital suffering greatly from loss of blood. Generous diet, rest, and vegetable tonics, restored her natural strength.

Amenorrhœa.—Nine cases of amenorrhœa are registered in the case book: seven of them simple, and two complicated. Six of the

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* For the statistical data of this department of the Reports, I am again indebted to my friend Mr. Lever, one of the Obstetric Clinical Clerks of the Hospital.

simple cases occurred in the persons of delicate females; and the remaining patient was a strong active plethoric girl of nineteen years of age. The former were treated by aperients and metallic tonics. Four employed the ammoniacal injection with benefit; while electricity in some cases seemed to be of great service, in exciting menstruation. In three of the cases of amenorrhœa, the patients' mothers had died with organic disease of the uterus. The two complicated cases are not without interest: in one, epilepsy was combined with amenorrhœa. This patient had a brother who was also liable to epileptic attacks. She had prescribed for her, pulv. digit. gr. i. pulv. myrrhæ gr. ij. ferri sulph. gr. i. syr. q. s. f. pil. ter die cap. She persevered with this medicine for seven weeks, without any return of the epileptic convulsion; and the catamenial secretion has also been established. In the case where hemiplegia was combined with amenorrhœa, notwithstanding the menstrual secretion was excited by the administration of steel and the use of the ammoniacal injection &c., the hemiplegia was not relieved: greater good was derived from a protracted course of the ext. nucis. vom.

Carcinoma Uteri.—No less than ten cases of this lamentable disease, in their various stages, have been received into the ward. In five, where ulceration had not gone on to any great extent, and where there were no fungoid excrescences, the application of the tinct. of iodine, by means of a camel's-hair pencil, through the speculum, seemed to improve the condition of the ulcers, and, for a time, to retard their progress. In most of the cases, the best mode of exhibiting anodynes appeared to be in the form of suppository.

Carcinoma Vaginæ—occurred in a person of the age of fifty years, where the catamenial functions had never been performed with punctuality. The inguinal glands were enlarged and indurated.

Chlorosis.—Seven cases of chlorosis have been received for treatment: in four of them, there was extensive tubercular disease of the lungs. The remaining three were of simple character, and were cured by a gentle but continued course of tonics; at the same time varying them, when the one in use seemed to lose its efficacy.

Engorgement of the Uterus.—This patient was a reclaimed courtezan. Cupping on the loins, absolute rest, abstinence from every species of excitement, laxatives, and sedatives, comprised the successful treatment.

Hydrops Ovarii.—Five cases have been received into the ward since the last report. Of these, four were married, and one was single: four commenced on the right side, and one on the left. Three cases were tapped, all unsuccessfully. The following table will furnish the chief points, at a glance:—

				Measurement below the Umbil.	
No. 1 aged 39, Unmarried	left side,	32¾ inch. stationary.
2 . . . 50, Married...8 child. 4 mis.,	right ditto,	44 do.	previously tapped.
3 . . . 37, Married...1 child, 8 mis.,	right ditto,	50¼ do.	died.
4 . . . 50, Married...9 child. 3 mis.,	right ditto,	50 do.	died.
5 . . . 42, Married...2 child. 1 mis.,	right ditto,	41¼ do.	died.

Hysteria.—This case was of an hysterico-epileptic character. The mistura assafœtidæ, as well as the enema assafœtidæ, was found of service: and although not cured, she was greatly relieved.

Induratio Oris Cervicisque Uteri.—In the two cases of induration of the mouth and neck of the womb, the women had borne children, and had long suffered from uterine irritation. In both, the induration extended over the whole of the os and part of the cervix, and interfered with the functions of micturition and defæcation, but more especially the former. Great advantage was derived from the application of the tincture of iodine to the part affected, by means of the speculum; at the same time, improving the general health of the patient. One left the hospital with the parts nearly in a natural state: the other fell a victim to erysipelas.

Inflammatio Mammæ.—In the only case admitted, abscess had already taken place; so that no opportunity occurred to put into practice the nauseating plan of treatment. The quinine, porter, generous diet, &c., were exhibited, to support the powers of the constitution. She left quite well.

Inflammatio Oris Cervicisque Uteri.—In the six cases of this disease, there was the creamy discharge; the central pains, increased by the erect position; exquisite tenderness on examination, and the humid and hot state of the os and cervix. Cupping on the loins, leeches to the vulva or vagina, mild saline laxatives, sedatives, anodyne injections (as the poppy, or conium), with perfect and absolute rest, comprised the successful treatment.

Inflammatio Vaginæ.—This case occurred in the person of a delicate woman of the age of 47, who had been married, for the second time, about three weeks. The recumbent position, cupping to the perinæum, leeches to the vulva, laxatives, &c., comprised the treatment.

Leucorrhœa.—In all the cases, the discharge was very abundant, and had existed for some time: in two, there was slight prolapsus of the uterus. The injections used were, the lot. arg. nit.; the lot. alum. comp.; the lot. ferri sulph.; the decoct. quercûs c̄ alum.; and the decoct. acic. clavi. These were frequently changed for one another, and with advantage. The internal remedies were, mild laxatives and tonics; the latter of two kinds, mineral and vegetable. Of the mineral

tonics, preference was given to the zinci sulph., ferri sulph., and tinct. ferri sesquichloridi. Of the vegetable tonics, the quinine seemed to be the most efficacious.

Menorrhagia.—Both the examples of this disease were of the passive kind. Both women had been married, had borne several children, and had repeatedly miscarried. Astringent injections, as the lot. alum. comp., and the decoct. aciculi clavi, were very beneficial; so also the internal exhibition of the aciculus clavus.

Procidentia Uteri.—In the four cases of this displacement, ulcera- tion of the os had occurred to some extent. Three of the patients had borne many children: one was of the age of seventeen, unmarried, and had never been pregnant, but was in the habit of lifting heavy weights. The lotio nig. c̄ mist. acaciæ et ext. opii was ordered at first, as a local application: afterwards, the arg. nit. completed the healing of the ulcers. Pessaries were subsequently used.

Prolapsus Uteri.—One case had occurred after a miscarriage at four months, attended with much hæmorrhage; one, after a tedious and difficult labour; and the third occurred to the person of a young woman, who, a few days after her admission, proved to be maniacal. In all, the constitutional symptoms were more distressing than in the instances of Procidentia.—Astringent injections were periodically and regularly persevered in; and afterwards the flat pessaries were introduced.

Prolapsus Vesicæ.—This case was difficultly managed: it followed a protracted and instrumental delivery. The lot. arg. nit. was used as an injection; and a sponge pessary was the support employed.

Puerperal Mania.—This patient was 27 years old, and had borne four children; her last labour occurring prematurely, and attended by great flooding. Three days after delivery, maniacal symptoms developed themselves: morphia, ammonia, with the tincture of hop, &c. were exhibited; but as her noise was prejudicial to the other patients, she was removed before her recovery.

Retroversio Uteri.—This patient was of the age of 41 years: she had borne ten children, and had miscarried three times. For five months she had observed a progressive increase in the size of her abdomen, which she attributed to pregnancy; but there were no other corroborative symptoms. For three weeks previous to her admission, she had been much annoyed by a constant "stillicidium urinæ." Soon afterwards, the swelling of the abdomen increased more rapidly, attended with great pain in the back, and a dragging sensation at the umbilicus: notwithstanding, she daily passed a considerable quantity of water, occasionally of a high colour. The swelling of

the abdomen was oviform, occupying its whole cavity, with a decided fluctuation on percussion, except at the upper part, where an indistinct boundary could be felt: its surface was tense, shining, and traversed by distended veins. The pulse was quick, the countenance flushed, and the respiration hurried. During the first night after her admission, she had passed two pints of urine by the voluntary efforts. On examination per vaginam, the os uteri could not be found; but a considerable gush of fluid of an urinous smell followed the introduction of the finger. Per rectum, a large tumor could be felt pressing upon and diminishing the calibre of that bowel. A female catheter was now obtained; but it was only after repeated solicitations, and almost compulsion, that the patient would allow it to be passed: its introduction was accomplished with great difficulty, as the meatus urinarius was drawn up above and behind the pubes. Upwards of eleven pints of ammoniacal urine were drawn off: after which, she was placed on her knees and elbows, and the uterus was restored to its natural situation. In three hours the catheter was again introduced, when three pints more urine flowed away. On the following morning, four-and-a-half pints more were drawn off. From this time the catheter was obliged to be constantly resorted to, to relieve the weakened bladder: in the course of five days she aborted of a three-months' foetus, and sank 96 hours afterwards.

Tumor Abdominis.—This case was supposed to be hard tumor of the uterus; but, on examination, it was thought to be connected with the omentum, and not in any way attached to the uterus.

Tumor Meatûs Urinarii.—Four cases of this painful affection were received for treatment. One was cured by the local application of the nitrate of silver. In two others, this remedy produced so much local and constitutional irritation, that it could not be repeated: the tinct. of iodine was then applied, and with success. In the fourth case, after repeated and unsuccessful employment of the nitrate of silver, Mr. Key attempted to remove the growth by the knife; but from the violent struggles of the patient, a young girl of 15, he could not succeed.

Tumor Ovarii.—Both these cases occurred in the left side, in single women. Iodine was employed internally and externally; omitting its use when the usual unpleasant symptoms were occasioned.

Tumor Uteri.—No less than nine patients affected with hard tumor of the uterus have been received for treatment. Six of these were unmarried women, and three married. In one, retroversion occurred; the weight of the tumor displacing the uterus. Iodine was administered to all; and although not to the dispersion of the

tumor, yet it greatly improved the patients' constitutional powers, and appeared to arrest the growth.

Vesico-Vaginal Fistula.—One of these cases was perfectly hopeless, from the great loss of substance that had taken place, the result of a tedious and protracted labour.   The other was nearly cured by the almost constant wearing of an elastic gum-catheter, and the very frequent application of the nitrate of silver to the opening.

Vicarious Menstruation.—In one case, the discharge occurred from the mamma: in the other, from the ear. This last patient was a native of London, twelve years of age. She began to menstruate when eleven years and eight months old; and was regular for three months, when the catamenia ceased. Occasional hæmoptysis, and discharge of blood from both ears, vicariously occurred. The ammoniacal injection, the tinct. ferri sesquichloridi, and electricity, were the means employed to effect a cure : this was accomplished in the former case; and the latter is now under treatment.

RETURN OF OBSTETRIC OUT-PATIENTS WHO HAVE ATTENDED AT GUY'S HOSPITAL FROM OCT. 1836, TO OCT. 1237.

In addition to those under treatment, new Letters have been granted to 497 patients, whose diseases were as follows:—

Abortio	11	
Amenorrhœa	34	
.... with Epilepsy	2	
.... with Bronchocele	1	
.... with Chorea	1	
Anteversio Uteri	1	
Carcinoma Uteri	33	
Chlorosis	41	
Climacteric Disease	6	
Diseases of Pregnancy	13	
Dysmenorrhœa	2	
Engorgement of the Uterus	3	
Hernia with Pregnancy	2	
Hysteria	21	
Hydrops Ovarii	6	
Indurat. Oris Cervicisque Uteri,	6	
Inflam. Oris Cervicisque Uteri,	10	
Inflam. Vaginæ	1	
Irritable Uterus	8	
Leucorrhœa	110	
Menorrhagia	23	
Over Lactation	33	
Pregnancy	26	
.... with Syphilis	5	
Procidentia Uteri	27	
Prolapsus Uteri	28	
.... Vaginæ	5	
.... Vesicæ	4	
Prurigo	4	
Retroversio Uteri	1	
Tumor Ovarii	14	
...... Uteri	4	
...... Vaginæ	1	
.... . Meatûs Urinarii	4	
Tympanites	1	
Varicose Veins of Vagina	1	
Vesico-Vaginal Fistula	1	
Vicarious Menstruation	3	
	497	

Of these 497 women, 368 were married; of whom, 206 married before the age of twenty-one years: 124 were single; and 5 were widows.

They had given birth to 1518 children; of whom 796 were boys, and 722 were girls. 161 of the women had miscarried; and the collective total of their abortions was 350. 275 are registered as being of light, and 222 of dark complexion.

Abortio.—Of the eleven cases of abortion, five were the result of violence; while in the remaining six the premature expulsion of the ovum seemed to be occasioned from the mothers' being affected with syphilis.

Amenorrhœa.—The cases were in number 38. 21 were of light complexion, and 17 dark. Their ages were as follow:

6 of the age of 15 years.		2 of the age of 21 years
4	16 ..	4	22 ...
4	17 ..	2	23 ...
5	18 ..	4	24 ...
2	19 ..	2	26 ...
3	20 ..		

The case in which bronchocele accompanied the disease was cured, under a long-continued course of the tinct. ferri sesquichloridi. The enlargement of the thyroid gradually disappeared, when the menstrual function was established.

The case, in which chorea was present, is also worthy of remark; as the convulsions ceased so soon as the uterus was made to perform its proper functions.

The two cases in which epilepsy was combined with amenorrhœa was put under the plan of treatment which was recommended by Dr. Bright to the Members of the Hunterian Society at the commencement of October 1836; viz. a combination of pulv. digit. ferri, sulph. and pulv. myrrhæ, taken three times in the day, in the form of pill. In both these cases, the fits became diminished in number, recurring at longer intervals; and the menstrual function became normally established. The last report we heard was—there had been no recurrence of the fits.

Anteversio Uteri.— This displacement of the uterus was well marked. The functions of micturition and defæcation were greatly interfered with. After the reduction of the organ to its right situation, astringents were ordered to be thrown into the vagina, and the patient was put upon a course of tonics.

Hydrops Ovarii.—These cases were six in number; and their particular features were as follows:—

No.	Age.	Married, or Single.	No. of Children.	Complexion.	Side affected.
1	32	single	0	D	left
2	26	married	0	L	left
3	37	ditto	0	D	left
4	50	ditto	8	D	left
5	45	ditto	6	D	left
6	34	ditto	0	D	left

Over-Lactation.—The cases of women suffering from over-lactation are no less than 33 in number. Their history is as follows:—

No.	Age.	Age when Married.	No. of Children.	No. of Miscarriages.	Complexion.
1	23	19	1	1	L
2	27	19	3	3	L
3	38	17	4	1	D
4	30	22	4	0	L
5	22	18	1	1	L
6	28	20	3	0	D
7	41	19	11	1	L
8	38	21	9	4	L
9	21	19	1	1	L
10	27	22	3	0	L
11	37	21	10	0	L
12	36	18	8	0	D
13	26	21	3	0	D
14	28	16	6	0	D
15	29	23	3	0	D
16	26	18	4	0	D
17	25	16	5	5	L
18	27	22	2	1	D
19	18	17	1	0	L
20	37	29	5	0	D
21	27	25	1	0	L
22	25	19	4	0	D
23	36	24	7	3	D
24	23	16	6	3	L
25	36	27	3	2	L
26	26	22	3	1	L
27	29	21	6	2	L
28	30	19	6	4	L
29	26	17	5	2	D
30	20	17	2	1	L
31	25	18	4	2	L
32	27	19	6	1	L
33	25	18	5	0	D

Tumor Ovarii.—These cases are fourteen in number. The following table will represent them:

No.	Age.	Married or Single.	No. of Children.	Side affected.	Comp.
1	67	M	11	left	D
2	52	M	1	left	L
3	28	M	0	left	L
4	25	M	0	right	D
5	35	M	3	left	D
6	44	M	9	left	D
7	32	M	3	right	L
8	34	M	4	left	D
9	37	M	8	left	D
10	45	S	0	left	D
11	25	S	0	left	D
12	50	M	8	right	D
13	45	M	6	left	D
14	26	M	3	left	D

Inflammatio Vaginæ.—The case of inflammation in the vagina occurred to an old woman 62 years of age, who had lived single till within a few weeks of her applying at this hospital. Her husband was 22 years old.

STATISTICAL ACCOUNT OF GUY'S HOSPITAL LYING-IN CHARITY, ESTABLISHED 1833.

From Oct. 1836, to Oct. 1837,
767 women have applied for Letters from the Lying-in Charity of Guy's Hospital.
Of these, 588 were English women
7 .. Welsh ..
3 .. Scotch ..
and 169 .. Irish ..

Total .. 767

The ages of these women were as follows:

No.	Years	No.	Years	No.	Years
1	16	39	28	16	40
1	17	46	29	6	41
7	18	66	30	9	42
20	19	35	31	2	43
24	20	23	32	1	44
28	21	36	33	3	45
37	22	33	34	0	46
38	23	27	35	0	47
48	24	30	36	1	48
41	25	18	37		
42	26	19	38	767 Total.	
55	27	15	39		

Of these 767 females,

		Years			Years
3	married at the age of	14	27	..	27
13	..	15	18	..	28
26	..	16	5	..	29
62	..	17	6	..	30
78	..	18	6	..	31
101	..	19	4	..	32
110	..	20	3	..	33
73	..	21	1	..	34
73	..	22	1	..	36
49	..	23	1	..	38
41	..	24	1	..	40
43	..	25	—		
19	..	26	767 Total.		

Of these women—107 are first pregnancies: the remaining 660 women had given birth to 2671 children; of whom, 2523 were born alive, and 148 were still-born.

Of the 2523 children born alive, there were 1397 boys, and 1126 girls.   Of the 148 still-born, 89 were boys, and 59 were girls.   237 of these women had miscarried, and the amount of their abortions was 348.

Of the 767 females, 367 are registered of light complexion, and 400 of dark.

From Oct. 1, 1836, to Oct. 1, 1837, 637 women have been attended by the Pupils belonging to the Obstetric Class of Guy's Hospital.

Of these 637 cases, there were,

  Cases of natural labour:

        Vertex presentation   581
        Face   ditto   7
                           ——588

  Cases of premature labour   4
  Cases of protracted labour:

        Delivered with perforator   1
        . . . . by action of ergot   3
                       —— 4

  Cases of preternatural labour :

        Breech presentation   10
        Foot   ditto   3
        Funis   1
                       —— 14

Cases of complex labour :

Twins	6
Placental presentation	3
Retained placenta	5
Puerperal convulsions..............	1
.... mania..................	1

—— 16

Cases of flooding labour.................... 10

Case of impracticable labour, from imperforate

os uteri................................. , 1

Total.......... 637

Patients delivered since Oct. 1833.. 1278

Total attended by the Charity...... 1915

		Males	Females
Children born alive	617 ; of whom	328	289
...... still-born......	26 ..	15	11
	643	343	300

Of the 26 children still-born,

         13 were vertex presentations,

      2 .. face ditto,

      2 .. premature labours,

      3 .. nates presentations,

      2 .. foot ditto,

      1 was shoulder ditto, (one of twins)

      1 .. funis ditto,

      1 .. placenta ditto,

      1 .. delivered by perforator,

Total, 26

Of the 7 face presentations,

      1 was of 5 hours' duration,

      1 .. 8 .. ..

      1 .. 10 .. ..

      1 .. 13 .. ..

      1 .. 15 .. ..

      1 .. 18 .. ..

      1 .. 29 .. ..

Total, 7

Of the nates presentations,

    6 of the children have been born alive; and

    4 still-born,

    ———

    10

Of the foot cases,

    2 were born alive; and

    1 still-born,

    ———

    3

Of the 6 twin cases,

    In 5, both children were females; and in

      1, one was a boy, and the other a girl.

2 cases, the vertex presented in both children;

1 ..   the vertex presented in both cases, but in one the face was situated anteriorly;

1 ..   the one was born under a vertex presentation; the other was a foot representation;

1 ..   the male was born with a shoulder presentation; the female (the first-born) with a vertex;

1 ..   the vertex presented in one child, the nates in the other.

Of these 637 women,

100	were	1st confinements,	12	were	10th confinements,
122	..	2d ..	5	..	11th ..
103	..	3d ..	7	..	12th ..
67	..	4th ..	3	..	13th ..
68	..	5th ..	2	..	14th ..
47	..	6th ..	0	..	15th ..
48	..	7th ..	1	..	16th ..
34	..	8th ..			———
18	..	9th ..	637		.. Total.

57 Cases occurred in the month of January,

42 .... February,

63 .... March,

57 .... April,

72 .... May,

43 .... June,

51 .... July,

53 .... August,

43 .... September,

52 .... October,

48 .... November,

56 .... December,

———

637 .... Total.

Of the 100 first confinements, 54 were males, and 46 females. Of the males, 52 were born alive, and 2 still-born; of the females, 43 were born alive, and 3 still-born.

Only two deaths occurred during the past year.

HISTORY OF A CASE

OF

DISLOCATION OF THE FEMUR.

RELATED BY DR. CUMMINS;

AND COMMUNICATED

BY SIR ASTLEY COOPER, BART. F.R.S. D.C.L.

As the following Case, which I have received through the kindness of Dr. Cummins of Dundee, is interesting in itself, and as confirming the statements of Mr. Morgan and Mr. Bransby Cooper in their accounts of the Dislocation of the Thigh-bone, (see Vol. I. pp. 79 and 97,) it has been thought desirable to publish it in the present Number of the Reports.

" Thomas S——, a carter, about 55 years of age, of relaxed and spare habit, on the night of January 8th, 1830, was proceeding homeward, in a state of inebriation, when he, unawares, stepped over the side of the road, and fell into the adjoining field, which was several feet below the level of the former. On recovering from the shock, he was unable to rise, and was conveyed home by some friends. A surgeon saw him about four hours after the accident took place: he found the right hip-joint much swelled and ecchymosed; which, with the intoxicated state of the patient, contributed to prevent his ascertaining the exact nature of the injury.

" On the 11th, the late Mr. Gibson of New Lanark, with whom I then resided as assistant, saw the patient for the first time; but, from the unusual nature of the symptoms, hesitated in his opinion, whether the case was one of dislocation of the joint, or fracture of the neck of the femur.

" On the 17th, the antiphlogistics previously employed having produced considerable abatement of the tumidity, Mr. Gibson thought that the bone was dislocated, and that an attempt might be made to reduce it. Extension, by means

of the compound pulley, was kept up during nearly the space
of an hour, while attempts were made to effect the restora-
tion of the joint to its natural state; but they proved ineffec-
tual.   The want of success induced Mr. Gibson to doubt the
correctness of the opinion which he had formed.

" Next day, 18th, being the 10th from the occurrence of
the accident, Mr. Gibson took me to see the case; when I
found the symptoms as follows, and was informed that they
were the same from the first, excepting the diminution of the
general tumidity.—The right limb was shortened by fully
three inches, and it could not be lengthened in any degree.
The knee and toes were very much turned out; and the
attempt to rotate the thigh inward produced exquisite pain,
without producing any change in the position of the limb.
Abduction and adduction were nearly equally difficult and
painful; but flexion could to a certain extent be performed
with less difficulty.   The hip was flattened; and the trochan-
ter major not to be discovered.   There was no hard or distinct
tumor on the pubes; but close below the anterior superior
spine of the ilium, between it and the situation of the inferior,
there was a very distinct, hard, round tumor, which could be
felt moving in unison with the thigh when flexion and exten-
sion were performed.   There was no crepitus, no possibility
of lengthening the limb, and, of course, no successive retrac-
tion on the removal of the extending force, as takes place in
fracture of the neck of the thigh-bone.   The tumor at the
anterior superior spine was fixed in its relative position; and
between its most prominent part, and the point of the spine,
the distance was only a few lines, and nearly in the perpen-
dicular, as it projected but little into the abdomen.

" My opinion being requested, I stated that the case was one
of dislocation; that I was satisfied that the tumor, situated
immediately under the anterior superior spine of the ilium,
was formed by the head of the femur; and that, in conse-
quence, the neck of the bone and trochanter major lay on
the contiguous portion of the dorsum ilii, above the acetabu-
lum.   It was objected, that such a position of the bone was
anomalous and unprecedented; and that if the head of the
femur were so dislocated, it was unlikely it would remain in
that situation, on the sharp ridge of the ilium: however, on

returning home, and explaining my ideas at length, and placing the dry bones in the same position as they were supposed to occupy in the Case, Mr. Gibson was entirely convinced; and we agreed that the reduction ought to be attempted, by extending the joint in a direction downward and backward, raising the head of the bone, and rotating the knee inward, so as to turn the head of the bone into the acetabulum.

"On the 19th, a grain of tartar emetic having been previously administered at short intervals till sickness and vertigo came on, the extension by means of the pulleys was gradually increased. Mr. Gibson, having a towel passed under the patient's thigh and over his own shoulder, raised the head of the bone, which now left its position at the anterior superior spine, and gradually came down; and then turned the knee firmly inward, at the same time pressing it towards the opposite one. The head of the bone glided into the acetabulum without any sound or snapping—the fact being only with certainty ascertained by our finding the prominence of the trochanter returned to its proper situation; the tumor, which was formerly at the anterior superior spine entirely removed, the knee and foot in their proper direction, and the limb of equal length with the other. The extending apparatus was removed, the patient's knees were bound together, and he was placed in bed. In a fortnight, he was sufficiently restored to be able to walk a short way out of doors, and soon entirely recovered from the effects of the injury.—The reduction was effected in about twenty minutes.

"The accompanying sketch, *Fig.* 1, shews the position of the dislocated head of the bone, which lay between the anterior superior, and anterior inferior spinous processes of the ilium; the neck of the bone, at its junction to the head, resting on the ridge between these points; while the trochanter major rested on the dorsum ilii, above the acetabulum; thus indicating a variety of dislocation hitherto unknown.— *A*, The superior anterior spine of the ilium. *B*, The inferior spine. *C*, Head of the femur.

"*Fig.* 2.—A copy of a drawing taken from a preparation presented to the Museum of Guy's Hospital by Sir A. Cooper; exhibiting the position of the bone in a species of dislocation

unknown before the preparation was obtained: it is given to shew the difference between it and the position of the bone in the case of T. S. Mr. B. Cooper describes the relations of the bones as follows:—'The head of the bone is thrown upwards, on to the brim of the pelvis, just to the inner side of the anterior and inferior spinous process of the ilium.' *a,* The head of the thigh-bone, lying in the new acetabulum. *b,* The projecting portion of newly-formed bone, overlapping the head of the femur. *c,* Trochanter major, resting on the new articulatory surface between the acetabula. *d,* A portion of the acetabulum seen below the trochanter major.— *Guy's Hospital Reports,* p. 98 of Vol. I.

" *Fig.* 3. is given to illustrate the supposed position of the head of the bone, described in a Case related by Mr. Morgan, at p. 79 of Vol. I. of Guy's Hospital Reports, as similar to that in the preparation represented in Fig. 2. Mr. Morgan's words are: ' The projection of the trochanter major was entirely lost, while the luxated head of the bone might be felt under Poupart's ligament, just below, and to the inner side of the anterior and superior spinous process of the ilium; *and apparently lying between the anterior and inferior spinous process of the ilium, and the junction of that bone with the pubes.* It thus rested upon the brim of the pelvis; and projected upwards towards the abdomen. The femoral artery was not displaced in this dislocation; but could be traced, taking its usual course, and consequently situated to the inner side of the displaced bone.'—In this Case, Mr. Morgan describes the foot as 'excessively everted, so as almost to give the toes a direction backwards;' which appears to me to have taken place in consequence of the trochanter having been turned into the acetabulum.

" 1. Anterior superior spine; 2. Anterior inferior spine; 3. Head of the bone below, and resting on the anterior inferior spine.

" F. CUMMINS."

"*N.B.* Mr. Morgan's case was on the left side. In the sketch, it is represented on the right, for the sake of comparison with the others."

Fig 3

Fig 2

Fig 1

A

C

B

a

b

c
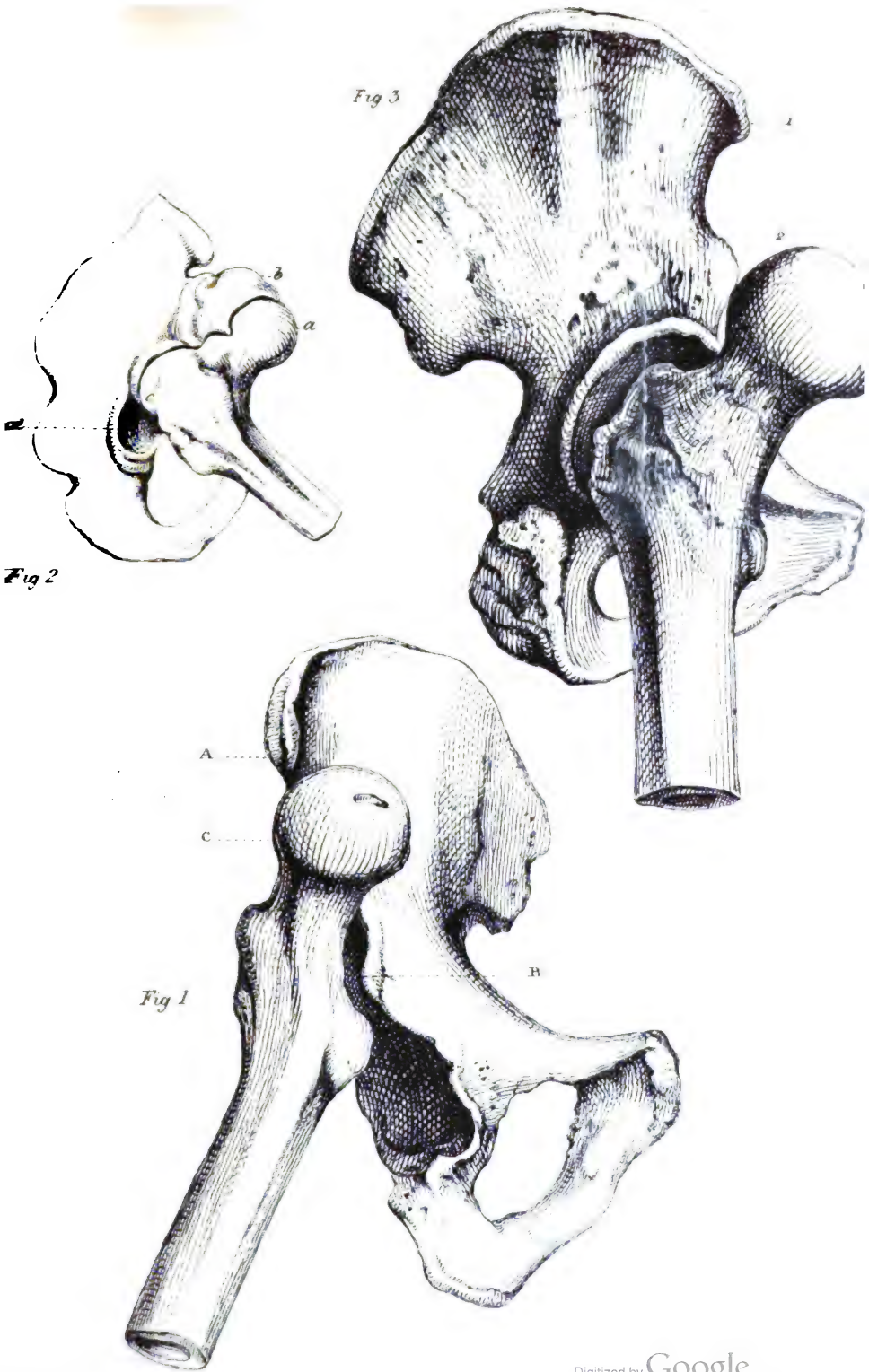
ACCOUNT

OF

A VERY LARGE CALCULUS

PASSED BY A YOUNG WOMAN,

(WITHOUT OPERATION)

A PATIENT OF MR. HARRIS, SURGEON,

AT REDRUTH IN CORNWALL.

COMMUNICATED BY SIR ASTLEY COOPER, BART. F.R.S. D.C.L.

MARY B ——, aged 18 years, had for seven years suffered from great pain in the pudendum, accompanied by an involuntary discharge of urine: but she could void her urine with much more facility when in the recumbent posture, than she could in the sitting position.

After a time, her pains became excessive, and like those of parturition: she had a sanguineous and purulent discharge in her urine: she lost her appetite, became greatly emaciated, and suffered from almost constant fever.

Whilst she was sitting upon a pot-de-chambre, endeavouring by very forcible efforts to discharge her urine, and which exertions she continued for ten minutes, the calculus passed with violence into the recipient vessel.

After the stone had thus escaped, she immediately began to recover; but her health was not perfectly re-established for twelve months.

Although she was 18 years of age when this circumstance occurred, the menstrual secretion had not appeared; but after three months, that change began to shew itself."

This case is remarkable, as shewing the powers of nature in removing a calculus of extraordinary magnitude, and from

the subsequent recovery from all the ill consequences which, for a time, it had produced.

ANALYSIS OF THE CALCULUS, BY DR. REES.

<div align="center">

Length . . . . . . 2⅝ inches.
Breadth . . . . . 1⅜ . . .
Thickness . . . . 1¼ . . .
Weight . . . . 651 grains.

</div>

Nodule adherent to the calculus . . . . { Oxalate of lime and
                                     fusible calculus.
Body . . . . Fusible calculus.
External porous layer . . . . Ditto.
Darker lines observable in the body }
    of the calculus . . . . } Lithate of ammonia.

The nucleus consists of a porous substance, with lithates of ammonia and soda deposited within it. The porous body consists of phosphate and carbonate of lime, and animal matter. On exposing it to the action of boiling water, and afterwards to that of dilute nitric acid, a spongy matter remained undissolved, which retained the form of the nucleus. It seems highly probable that this central substance is bone.

DESCRIPTION OF THE PLATE.

THIS drawing correctly represents the form and dimensions of the calculus, passed spontaneously through the urethra, by Mary R——, aged 18 years.

Fig. 1. External view of the entire calculus.

Fig. 2. View of a section, in which the laminated structure and the form of the nucleus are seen.

Fig. 3 & 4. Views of the nucleus, as it appeared when the body of the calculus had been dissolved away. A cellular texture is apparent.

Fig 1
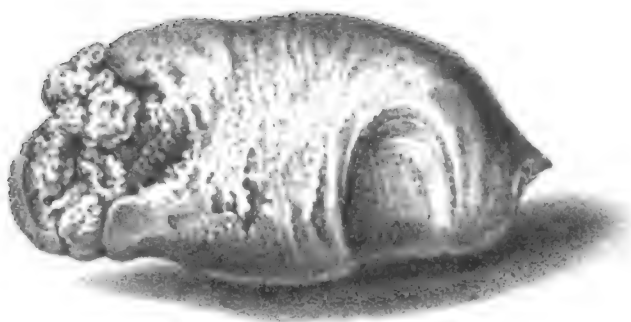
Fig 2

Fig 4.

Fig 3.

ON THE OCCURRENCE

OF

WHITE PATCHES ON THE SURFACE

OF

THE HEART;

AND ON THE INDICATIONS THEY AFFORD OF ATTRITION AND DISTENTION.

BY T. W. KING.

WHITE patches affecting the close pericardium are among the most common of all morbid appearances in the human body; and, inasmuch as they appear to me to supply important pathological evidences of preceding states of the circulation in various ways, but more particularly in relation to the distention and reflux action of the right ventricle, I have thought them deserving the attention of all who examine the heart, with the view to ascertain, after death, the probable circumstances of its actions in life. The variety of their appearances, the mode of their production, together with their different sites and causes, may be easily considered in a very brief space.

Dr. Hodgkin, in his very clear and complete account of the pathological anatomy of the serous membranes, thus describes these patches:—

" It is very common to find one or more opaque white patches on the surface of the heart. Dr. Baillie says, that they may be dissected off; and Laennec says, that this is frequently the case. I have met with one or two instances, in which this might have been done; but I certainly agree with Corvisart, in thinking that, in by far the greater number of cases, these patches depend on a deposit on the attached surfaces. They are generally found on the anterior part of the right ventricle, and rather nearer to the apex than to the base of the heart: they are, however, by no means confined to

this situation. Respecting the cause of these spots, which can scarcely be regarded as a morbid appearance, nothing certain is known. From the circumstance of their being often found immediately under the sternum, and from their being occasionally met with on other parts of the heart, to which a firm and resisting body has been unusually opposed— as, for example, where a bony deposit has taken place beneath the reflected pericardium, or when an uneven and remark- ably indurated liver has, even through the diaphragm, pre- sented an unequal pressure against a particular part of the heart—I have thought it probable, that such pressure, aided by the movements of the heart itself, may have led to the production of these spots. These formations may certainly take place at a very early period of life. I have met with one rather loose and thick, but in other respects perfectly resembling those found in the adult, on the right ventricle of the heart of a child only ten weeks old. Similar thickening of the close pericardium sometimes marks the course of the coronary arteries and their branches; and this circumstance, amongst others, tends to confirm the idea which I entertain, as to its mode of formation."

It is, I think, quite certain, that in many more than half the bodies examined beyond the ages of infancy, a white patch, such as is spoken of above, will be found pretty near the middle of the anterior surface of the right ventricle, varying from about the size of a shilling to that of a half-crown piece, deviating more or less from a circular figure, about twice or three times as thick as the natural adjacent membrane, having an even smooth surface, defined but not abrupt edges, and a bluish-white hue, not always quite devoid of trans- parency. I have also remarked similar appearances almost as early in life, I believe, as Dr. Hodgkin. The extent of these patches, it should be remarked, is by no means to be exclusively defined as is here stated: they will not un- frequently be found considerably larger. I have by me sketches and notes of a Case which was not less remarkable on other accounts :—

" GEORGE WEEK, aged 44, a powerful and bony person, accustomed to labour and severe exertions, was found, after

death, to have a powerful heart; and a triscupid valve, which
I deemed healthy, but unusually well calculated to admit of
reflux under distention. The surface of the right ventricle
was also remarkable: anteriorly, a uniform whitish thick-
ening of the close pericardium accurately marked out the
limits of this cavity, with the exception of a broad line along
the acute margin, and a band at the base between it and the
auricle. A continuance of this white patch likewise reached to
near the bifurcation of the pulmonary artery on the anterior
surface only of this vessel, in the form of a broad even band.
The under surface of the ventricle presented two similar
patches; which left very little of this surface free, except what,
like the margin, was covered with fat.—The surface of the
right auricle likewise presented two patches larger than a
shilling."

Anterior View.   *Posterior View.*

Dr. Barker, of St. Thomas's Hospital, who has been much
engaged in morbid anatomy in that Institution, shewed me,
about the same date, a preparation which he had preserved
for other purposes, in which the opaque thickening or patch,
which we are considering, was even more marked over the
right ventricle. Indeed, a greater or less approach to this
appearance is by no means very uncommon.

That these formations are morbid, there can be little doubt.
Dr. Hodgkin seems to have entertained the opinion, that they
were attributable to a kind of inflammation, originating in

attrition and irritation.   As to the actual seat of the deposit,
I rather suppose it to be in the proper tissue of the serous
membrane.   One case occurred to me, in which the patch,
on the usual place, was about three times as thick as the na-
tural membrane, and larger than a shilling, but, as yet, quite
translucent; and, though firm, seemingly œdematous.   This,
which I regarded as about to become opaque, seemed pretty
evidently a thickening of the original tunic.   I imagine, how-
ever, that, occasionally, layers may be dissected from either
surface without affording any very satisfactory inference as
to the seat of the adventitious deposit, with regard to the
actual site of which it may not be very material to determine.
With regard to their cause, I do not entertain much doubt,
that it is always inflammatory, and pretty constantly the
effect of friction and irritation.

The various forms of opacity in the arachnoid, pleura, and
peritoneum, but especially on the spleen and liver, all tend
to illustrate and complete our notion of the successive changes
by which such condensed portions of thickened serous mem-
brane are produced; and the appearance of defined white spots
within the ventricles, produced by the rubbing of diseased
portions of the valves, is equally characteristic of irritation
and inflammation.

Now, the situation of these patches, wherever they occur,
implies to my mind a degree of attrition at the part, more
than belongs to the pericardium generally.   They are found
on the surface of the right auricle, almost as frequently as on
the ventricle, but not in so marked a form; and much more
divided, even minute, and often clustered like the rippling on
the sand at ebb-tide.   One is not unfrequently seen along the
anterior face of the great pulmonary artery.   All these relate
to the right side of the heart, which, all pathologists are aware,
is often, and more than the left, the subject of distentions.
The patches may occasionally, perhaps, be seen on any part
of the close pericardium.   I have seen them behind the left
pulmonary veins; but, omitting this instance, the next most
common appearance of the kind is that of lengthened, narrow,
winding, and even branching lines immediately over the
great vessels of the ventricles, whenever they are the subject

of considerable dilatation. Here, also, we have evidence of a disproportionate share of attrition, resulting from undue prominence.

Lastly, in the order of frequency, I have noticed, that with hypertrophy of the left ventricle (rather than with an uniform dilatation) two or three points of its surface seem subject to these opacities, but in particular one pretty close to the apex anteriorly: all of these spots, however, have appeared to me to project, and be more liable to irritation; and every now and then, in such a case as of hypertrophy, the patch is converted into a band of firm adhesion.

As I feel convinced that what has been here described is to be met with, in some shape, in far more than every second inspection, and as I think the appearances constitute important indications of preceding states of different parts of the circulation, I have given the appearances, generally, the name of *patches of attrition* * : but I have appropriated that of *patches of distention*, especially, to those on the anterior face of the right ventricle, which were first described; for the reason, that they belong to a particular set of phænomena, and are so constantly found.

It may be admitted, that the right ventricle is liable to very varying degrees of afflux and distention, whether under the circumstances of pulmonary impediment, of sanguineous repletion, or of a sudden venous afflux under exertions: and here it is, I think, important to remark, that when the *patch of distention* is not larger than a shilling it will easily be

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* I accidentally met with the following observation by Dr. Hodgkin, some time after completing the above remarks:—

" In an adult male patient who appears to have been carried off by phthisis, the heart was extremely small, and devoid of fat. There were two opaquish white patches; the one on the anterior, and the other on the posterior side of the heart; such as are often found in these situations, and appear to be the result of contact. It is not often easy to decide, whether these patches are on, in, or beneath the pericardium; but in this subject, although the polished surface of the pericardium appeared to be continued over them, they might be detached, leaving the substance beneath still covered with serous membrane. Hence it may, perhaps, be inferred, that these patches of partial thickening belong to the membrane itself, which, in this emaciated subject, admitted the separation of its layers." *Vide* 13. 4to Vol. *of MS. Inspection Records, by Dr. Hodgkin,* (G.I.B.) *in Guy's Museum, Sept.* 7, 1835.

perceived that the portion of the right ventricle's paries, on which it has been produced, is that which, from its adaptations, should be expected to yield most readily to an accumulating mass of fluid within: and when the ventricle is found distended, the patch surmounts the most prominent part.

I have to observe, also, that it is beneath, or rather near to this point, that the moderator band of distention is inserted —that particular muscular cord which crosses the cavity of the right ventricle, from the solid to the yielding wall; and which, while it is adapted, by no means strongly, to limit distention, appears intended to regulate the position of the largest of the columns of distention which belong to the safety-valve, or the apparatus of reflux.

ON

A MORBID FLATTENING OR COMPRESSION

OF THE

LEFT BRONCHUS,

PRODUCED BY DILATATION OF THE LEFT AURICLE.

BY T. W. KING.

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A PARTICULAR morbid effect, which, as far as I am informed, has not been made known, and which, as I believe, is of rather common occurrence, is the flattening and obstruction of the left bronchus, when the left auricle is dilated so as to press upon this air-tube. Our Collection affords three specimens of this affection; and I think I may say, I have remarked it many times, in different degrees. I propose to make a brief reference to the most remarkable instances of those which I have recorded; as well as to a few concurrent circumstances, which may explain what is necessary to the production of this compression, as well as what should be looked for in connexion with it.

I have been able correctly to anticipate the existence of this change, by considering the state of the heart; but I have hitherto perceived nothing distinctive in the respiratory sounds, and, indeed, should not expect to do so.

CASE 1.—*June*, 1834.

THE earliest occasion on which it occurred to me to notice the bronchus thus flattened, was in a boy fifteen years of age, who about five years before had suffered both from rheumatism and an accidental injury to the chest, and had had more or less palpitation and dyspnœa from that period. These affections, with serous effusions, were the apparent causes of death.

We found almost universal adhesion of the thoracic serous membranes, a copious œdema in that of the pericardium, and

a limited but full hydrothorax beneath the base of the left lung, which was dark and tough, and all parts contained very little air or fluid; yet it did not appear fully contracted or compressed. The right lung was somewhat more aërated, turgid, and œdematous, but scarcely more lacerable. The left bronchus was flattened by pressure of the dilated auricle.* The air-tubes contained a dull loose mucus, and their lining was deeply red and thickened. The heart was greatly enlarged. The left ventricle was most hypertrophic; and the left auricle most dilated, having a thick opaque lining, spotted with atheroma. The mitral curtains were thickened and granular, and closed imperfectly—I conclude, owing chiefly to dilatation of the ventricle, and consequent traction of the cords.

The right side of the heart was less, but not inconsiderably affected. There was little abdominal congestion; but some other chronic affections were in considerable force.

CASE 2.—*April*, 1835.

ROBERT M., aged 28, may have had occasional symptoms of chest obstruction for a long time. We did not learn what had given rise to his disorder. He had been markedly ill, for two months, with catarrhal affection. It was thought right to treat him rather actively. There was manifestly disease of the heart; and twenty-four days after he was first noticed, a distressing palpitation began. In five days more he died.

He was found to have a closely-adherent pericardium. All the cavities of the heart were greatly dilated; the left auricle most of all; and the left ventricle least. Both ventricles appeared moderately hypertrophied, but the auricles were less so. The heart's substance was decidedly loose and unhealthy. The mitral opening was reduced to an oval fissure, $\frac{3}{4}$ of an inch by $\frac{1}{4}$, with a firm thick margin. The lining of the cavities was opaque, and thickened unequally; mostly, that of the left auricle; and least, that of the right ventricle.

The lungs were not adherent, but large and firm, fleshy, turgid, and œdematous; nowhere airless, but evidently emphysematous.

The bronchial lining was pretty full and dark; the secretion

* See Prep. No.1717¹⁰, and those adjoining.

copious, viscid, and discoloured. The left bronchus, close by, its first divisions, was decidedly flattened.

The left lung seemed somewhat more solid; and less in size than the right. The left pleura contained half a pound of clear fluid, and the right about two ounces and a half.

The liver had a nutmeg aspect: the spleen was roundish and fleshy, and its tunic thickened.

There was a quart of serum coagulating in the abdomen.

Without and within there were other signs of venous congestion; and there were other appearances, not essentially connected with our present object.

Case 3.

Lydia P——, aged 21, was under Dr. Cholmeley's treatment during two months, for a general dropsical affection, which was referred, in part, to an enlarged liver : there was evidence, however, of the chest diseases. She was ill altogether twenty months. She died with most parts of the body œdematous.

Some little effusion was found in the abdomen, and but a little in the thorax, with recent traces of pleuritis on both sides.

Both auricles of the heart were greatly dilated, and some-what thickened: the left was the more capacious. The right ventricle was thick and very large, and the free edges of the tricuspid curtains thickened, and perhaps contracted. The dimensions of the left ventricle were more natural; but it was too capacious, and rather hypertrophic. All the substance of the heart was rather flabby, tough, and dark. The mitral curtains and cords were very much thickened and contracted, also firm and yellowish—certainly, the valve could scarcely close well. The lining of the left auricle was opaque, thick, and uneven. One lung was turgid, dark, and œdematous: the other was, in addition, more fleshy and lacerable, and contained several small, firm, dark, apoplexies, indistinctly bounded *. Both lungs were most affected posteriorly, and their bronchial lining was much injected; the contents dark, foamy, and abundant. The left bronchus, behind the

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* My notes do not distinguish here the right from the left.

ventricle, was evidently greatly flattened. The liver was rather large, pale, coarse and fleshy, and the spleen small, firm, and darkish.

<div align="center">CASE 4.</div>

A little child, two years and four months old, had had dyspnœa from the first months of its life, with a cerulean hue, and frequent palpitations; and died anasarcous, with the spleen greatly enlarged.

On examining the heart and the adjacent parts, we found the two ventricles dilated and hypertrophic; but the right cavity was more than proportionally wide. The valves of both ventricles seemed imperfect. The right auricle was dilated, and the left very much so, and also thick. The foramen ovale admitted a catheter from right to left only.

The bifurcation of the trachea appeared very slightly compressed, and even the commencement of the right branch; whilst the tube on the left side was much and permanently flattened.

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I have observed one other case fully as well marked as the preceding, and several other less complete alterations; and from all I have seen, I am led to conclude that the first evident degree of change is that in which the anterior surface of the tube in question forms a wide and simple plane. It can scarcely be questioned, when the tube is diminished to two-thirds, or one-half of its natural calibre —independently of permanent or transitory affections of the lining—that its defect is a very important item among the thoracic obstructions in any given case; but unless the narrowing were still more complete, a specific indication is scarcely to be looked for. I have seldom found the tube reduced to less than one-half of its natural extent; and I would merely observe, that the little advantage derivable from these notes probably depends on the illustration they afford to the general progress of diseases.

OBSERVATIONS

ON

ABDOMINAL TUMORS

AND

INTUMESCENCE:

ILLUSTRATED BY CASES OF OVARIAN DISEASE.

BY R. BRIGHT, M.D. F.R.S.

PHYSICIAN EXTRAORDINARY TO THE QUEEN.

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THERE are, unquestionably, no forms of abdominal tumor, with the exception of that which is occasioned by the uterus in a state of pregnancy—if that natural enlargement deserves to be spoken of as a tumor—so frequent as those which arise from the uterine appendages; and which, as they often involve, and most frequently originate in, one or both of the ovaria, have acquired the name of ovarian tumors; and, when accompanied by the accumulation of fluid which often takes place within them, the denomination of ovarian dropsy. At the same time, it is right to bear in mind, that the analogy between these and other forms of disease, usually denominated dropsies, is very slight.

There are, perhaps, four distinct diseases which form pelvic tumors with fluid contents, and which are therefore spoken of as ovarian dropsies. The first presents itself as a simple bag, containing serum; whose external surface appears to possess all the attributes of the peritoneum, attached to the surface of the ovary or some neighbouring part, and supplied by blood-vessels from the point whence it arises; sometimes, sessile; more frequently attached by a longer or shorter neck; generally single; but occasionally presenting the appearance of being composed of more than one cyst. (Plate X. Fig. 1.) This simple cyst, with a long footstalk, is not of unfrequent occurrence; and is sometimes congenital, or at least exists within a very few months after birth. The tumor is generally of small dimensions, from a size less than a pea, to that

N 2

of an orange; and, though I have no case to adduce, it is
not improbable that it occasionally attains to a considerable
bulk. The sessile variety of the simple cyst often develops
itself in the broad ligament; and appears still more decidedly
placed beneath the natural fold of peritoneum than the last
variety, so as apparently to involve within it the Fallopian
tube; which, however, is found passing round it, and not ma-
terially altered from its natural state, or slightly dilated, but
not communicating with the cyst. Of this we have a spe-
cimen in the Museum of Guy's (Plate X. Fig. 3); the ovary
of that side being, at the same time, quite sound and healthy.
In another specimen (Plate X. Fig. 2), where a simple cyst
of the size of an orange appears in a similar manner deve-
loped in the broad ligament of the uterus, having the Fallo-
pian tube on its outside, no ovary is discoverable; and
therefore it is doubtful whether the cyst is not the product of
a diseased condition of the ovary itself.

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The second source of tumor containing fluid, connected
with the uterine appendages, is found in a distended state of
the Fallopian tube, which is not unfrequently seen obstructed
and filled with serous fluid, so as to be much dilated, forming
a pouch of considerable size; and often both of the Fallopian
tubes are similarly affected. Whether, however, the dilata-
tion is ever of such dimensions as to present a very distinct
elevation above the pubes, I cannot say from my own obser-
vation: I have much more frequently found these sacs capable
of containing a few drams, or at most an ounce or two, of
fluid. One, which is preserved in the Museum of the College
of Physicians, and of which a plate has been published in Dr.
Seymour's excellent treatise on the diseases of the ovary, is
five or six inches in length, and would probably contain half
a pint of fluid.

It may not be altogether out of place, to mention here the
distended state of the Fallopian tube; which sometimes occurs
from other causes, particularly from purulent and scro-
fulous deposits: this, however, is a disease which has never,
in my experience, arrived at sufficient size to form a decided
abdominal tumor; and is usually so complicated with scrofu-

lous or inflammatory affections of the peritoneum, as to form an undistinguishable portion of the original disease.

The third form of tumor, the existence of which, as a separate disease distinct from others, appears to me very doubtful, consists of a simple vesicular body developed beneath the proper tunic of the ovary; supposed to be produced by an accumulation of fluid in one of the Graafian vesicles. Tumors, said to be of this kind, differ greatly in size: they are frequently not larger than a hazel-nut; sometimes of the size of an egg; and occasionally are believed to attain to a great magnitude, so as nearly to fill the abdomen. Yet, from the description which has sometimes been given of the contents of such supposed cysts and their glutinous quality, it is probable that they have often been no other than largely developed cysts of a malignant character. There is a state of the Graafian vesicle by no means uncommon; and of which we have several specimens in the Museum of Guy's, where a coagulum, more or less stained with blood, or of a somewhat glutinous character, is collected in the vesicle, distending it to the size of a hazel-nut, or sometimes larger: this, likewise, bears a doubtful relationship to the malignant forms of tumor; but from the circumstances of some of the patients and their youthful age, I suspect that they are, at least occasionally, unconnected with such disease. (See Case 2.)

The fourth is by far the most frequent form of ovarian tumor; and is essentially a specific disease, assuming all the varieties of structure which result from the numerous modifications of that morbid action called malignant. When speaking on this subject in a former paper in these Reports (Vol. I. p. 638), I endeavoured to point out, that the malignant disease was probably to be traced as originating more peculiarly in the cellular tissue of the body; first displacing, and then gradually involving and implicating, the proper structure of the organ in which it is developed. I need not, on the present occasion, repeat what I have already said; but having there mentioned ovarian tumors as affording some marked examples and very striking modifications of this fact,

I shall refer to the cases and dissections I am about to state, as illustrating the extensive growth and propagation of malignant disease in the loose cellular tissue of an organ, the more essential parts of which seem to present, in their natural structure, a prototype of that involved system of cellular arrangement observable in malignant growths. But here I must observe, that the development of the disease in the ovary, owing to the decidedly cellular character of its various parts, seems, even in its early stages, to lay hold on the most important portions of the organ, as well as on the common cellular tissue; and it is often quite impossible to say whether it be the meshes of the cellular tissue, or the vesicles of De Graaf, which are become the seats of the morbid deposits, or to what extent new structures have been generated; for, looking at the innumerable cysts, vesicles, and cavities which display themselves in the various parts of these ovarian tumors, we may sometimes doubt whether they have all of them had a portion of the natural structure, complicated as it is, even as the commencing nidus of their growth; but are inclined to grant, that new vesicular bodies may probably have been added in the progress of the development, such as Dr. Hodgkin seems to consider almost essential to malignant disease : and yet, when we look to a portion of loose cellular tissue which has been distended with air or filled with serum, we find no apparent want of cellular cavities, to bear out the possibility of the contrary supposition.

It is evident, that a disease consisting of a simple cyst filled with a bland inoffensive serum, apparently originating in some excess or irregularity of a comparatively healthy action, or arising from some inflammatory deposit, ought not to be confounded with any form of malignant disease, from which it must so essentially differ. Unfortunately, it is no easy matter to distinguish, with certainty, these two diseases ; nor, indeed, does the subject often admit of perfect elucidation, either during life or after death. Still, however, we must endeavour to take as our guides the best indication we can find, in the age of the patient, the progress of the enlargement, or the feel of the tumor. I do not profess to be conversant with the history of the simple cyst: I believe that the only indication afforded is a tumor, more or less spherical,

felt first in one of the inguinal regions of the abdomen, and
very gradually, if at all, ascending. That this may take
place very early in life—that its growth is slow—that the
constitution suffers little or not at all—and that after the cyst
has attained even a large size, it occasionally disappears,
without any very evident cause, or under the action of reme-
dies, or from being burst internally by some accidental
occurrence—the fluid, in this last case, passing off by the Fal-
lopian tubes, or taken up by the absorbents, and hurried very
rapidly through the kidneys; and though this effusion of
fluid may be accompanied by a certain degree of peritonitis,
the symptoms are, in general, by no means so alarming as
might be expected. I am not sure that I can recall to my
memory a single dissection where the simple ovarian cyst
has been the cause of death, or has even advanced to such a
size as to be the subject of material inconvenience to the
patient during life. In most of the cases—and they are pretty
numerous—in which simple cysts have been discovered after
death, they have been too small to have attracted notice
during life, and have been casually detected. Their attach-
ment has been even more frequently to the Fallopian tubes,
or to their fimbriated extremity, than to the ovaries them-
selves; and they have seldom exceeded the size of a small plum.
The subjects in which they have occurred have varied, as to
age, from children in arms, to women in the decline of life;
and in these latter cases, though still small, they have often
borne, in their structure, such evidence of having long existed,
that I am inclined to believe their increase to be generally
very slow; and that they frequently become stationary at an
early period.

With regard to the accumulation of fluid in a Graafian
vesicle, leading to its gradual distention, this likewise can-
not easily be detected; and, if detected, must with great
difficulty be distinguished from other forms of ovarian
tumor. As soon as it has acquired a sufficient size, it
will, of course, be felt rising from the pelvis; less spherical,
and less moveable, than the simple cyst; less lobulated than
the malignant disease: which circumstance, together with its
more moderate growth, and the little inconvenience it pro-
duces, may afford a clue to our diagnosis, and guard us

against an inordinate anxiety for the result. It is probable, however, that this form of tumor more frequently attains a large size than the simple cyst; and that it more frequently affords those instances of sudden disappearance, by accidental rupture of the cyst, or of gradual decrease, assisted by medicine, than any other form of ovarian growth. When rupture takes place, there is very often a more or less acute inflammatory action induced; and, according to the various circumstances arising from that inflammation, the succeeding history of the disease will be modified. Still, it is a fact, that from a very early period of its history, to the very end, we are not only unable to make any decided distinction between it and the malignant disease during life; but are seldom able to demonstrate, even after death, the precise nature of the tissue in which the cyst has been first developed.

With the history of the more ordinary form of ovarian tumor we have, unfortunately, very frequent opportunities of becoming acquainted; and I will endeavour shortly to state the prominent points which it presents. This form of disease seldom shews itself much before the twentieth year of life, and generally much later; and is not, like the simple cyst, unexpectedly discovered during the examination of children, or young persons, who have died of other diseases. The first recognised symptom is usually a tumor, not altogether devoid of pain, in one of the inguinal regions; and which, on examination, evidently rises out of one side of the pelvis, and even at this early period is sometimes distinctly lobulated or uneven in its form, and unequal in the resistance its different parts afford on pressure. The growth of this tumor is, on some occasions, so unperceived, that though it may have originated on one side, it has already risen into the pubic, and even the umbilical region; and when the medical man is first consulted, its lateral origin is with difficulty ascertained. At other times, the enlargement is at first slow; and after some indefinite period, the increase takes place suddenly; so that, in a few months, the whole abdomen presents, to a common observer, the size and appearance of pregnancy far advanced. From this time, the patient often asserts that the abdomen does not increase; and she willingly deceives herself, by measuring at some particular part; when

it often happens, that, with a little unconscious adjusting of the measure, no increase is discovered : but, in the mean time, there is no doubt in the mind of the medical attendant that the tumor becomes more and more tense—that the fluctuation bespeaks a further thinning of the parietes—that the functions of the abdominal viscera are interfered with— that the respiration is more embarrassed—and that increased pressure is made on the cava and other returning vessels; as evinced by the serum, which now begins to accumulate in the cellular membrane of the lower extremities, and the dis- tention and turgescence of the subcutaneous veins of the abdomen: the important question of paracentesis presents itself; and to this operation, however unwillingly, he finds himself at length necessarily reduced.

When a physician is consulted, either at this or in any pre- vious period of the disease, a careful examination of the state of the abdomen is necessary. In passing the flat hand cautiously and regularly over the abdomen, the extent of the tumor will often become at once manifest to the touch: at other times, no limits will then be discovered; for the tumor occupies the whole of that part of the abdomen which is not formed by the concavity of the diaphragm, the recesses of the loins, and the hollow of the pelvis. (Plates VI. VII. and VIII.)

Casting the eye over the abdomen in the earlier part of the disease, the greater rotundity or projection of one part will often be most apparent; and the tumor will in this way im- mediately discover itself, as occupying the iliac and lumbar region on one side, and extending over half at least of the um- bilical region, or beyond the umbilicus, so as to encroach on the opposite side: at other times, its extent will be less ; while in the more advanced cases no inequality will strike the eye ; but the rounded form of the abdomen, while the patient lies on her back, will contrast it with the more ordinary ovoid ap- pearance of ascites, as well as distinguish it in some degree from the form produced by the uterus distended in pregnancy. In many cases moreover, the eye will be struck by a great enlargement of the subcutaneous veins, as I have just ob- served, and such as often takes place to a still greater degree in ascites.

On making more firm though not violent pressure on the

various parts of the abdomen, we often find at once the general sense of fluctuation; and ascertain inequalities which neither the eye, nor the hand when passed but gently over the surface, will enable us to detect: and then it sometimes happens, particularly if the abdomen be not very tense, that we discover considerable masses of unyielding matter, partaking of the general rounded feel of the whole disease, but conveying the impression of more or less flattened spherical bodies attached to the inside of 'the fluctuating tumor; and these' bodies are sometimes so large, and sometimes so variously placed, as to suggest, to the inexperienced observer, the idea that the liver, the spleen, or the kidneys, are enlarged, and in some way involved in the disease. (Plate I. Fig. 2.)

Sometimes the sense of fluctuation is very indistinct or very partial, and various parts of the tumor yield it in different degrees. At other times, the fluctuation is even more evident than in the most extreme cases of ascites; and sometimes, as the patient lies on the back, a thin layer of fluid is discoverable, external to the great distending tumor; so that when the points of the fingers, placed on the surface, are moved forwards with a jerk, they are evidently resisted, after pressing aside a little fluid, by the surface of the tumor within. Sometimes this layer of fluid extends over a wide space; and the fluctuation it yields by percussion may be plainly felt, or even seen as a wave passing over a large portion of the abdomen.

The use of percussion is likewise very important in these cases; not only as detecting the existence, precise situation, and extent of fluctuation, but as eliciting sounds, hollow or otherwise, in the various parts of the abdomen. These will, of course, vary as the disease advances, pushing before it the hollow viscera; and in this consists one of the remarkable differences between ascites and ovarian disease. In ascites, as long as the peritoneum has undergone no serious change, the hollow viscera float upon the surface of the fluid, and rise to the highest part, whatever position almost the body assumes; but the ovarian disease displaces these viscera, and retains its relative position under all circumstances; so that instead of discovering the clear sound yielded by percussion in the umbilical region or at the scrobiculus cordis, or in the

lumbar spaces, according as the patient lies upon her back, stands erect, or reclines to the right or to the left side, we find the chief sound of the hollow viscera always on the side opposite to the tumor, till, by its encroachment, it has driven the intestines entirely into the outskirts of the abdominal cavity (Plate I. Fig. 1): and to this the exceptions are very rare; unless it be in those cases where communications have taken place between the cyst and the intestines, and thus air has been admitted.

Having ascertained the existence of a tumor or cyst, it will still further be right to examine carefully the state of the subcutaneous cellular membrane, to detect any traces of the existence of scirrhous or other tubercles deposited in it. And lastly, by applying the palm of the hand pretty firmly on the integuments covering the tumor, we should endeavour to ascertain whether, by its motion, we can discover any such crepitation, or rubbing sensation, as would lead us to infer the probability that adhesive effusion or adhesions existed between the tumor and the peritoneum lining the parietes of the abdominal cavity.

When by all these indications, and, if any doubt have arisen, by an examination per vaginam, the extent, the nature, and the circumstances of the tumor, and the existence of a fluid, have been ascertained, then, if the various functions have suffered so much interruption that prudence will allow of no further delay, the fluid is drawn off by the trochar; ten, twenty, or thirty pints of the contents of the cyst are discharged; varying in quality, but generally less clear in its colour, and more mucous in its consistence, than the serum of ascites.

The operation is attended with very little pain, and followed by very little constitutional disturbance, but affords the most marked relief; and, for a few days, the comfort of being freed from such a burden is most gratifying to the patient: still, however, she is not unfrequently disappointed that the size of the abdomen is not more completely reduced, and the large masses and nodules, which were but indistinctly felt, or discovered by the dulness yielded locally by percussion, are now not only easily grasped by the hand, but present large and obvious elevations and irregularities in the contour

of the flaccid abdomen (Plate I. Fig. 2).—Not many days elapse, before the regular and spontaneous tightening of the bandage with which the body has been swathed, and which percussion shews to depend on no accidental evolution of flatus, gives warning of the speed with which fresh accumulation is taking place; and there is too often reason to believe that the rapidity of the effusion is increased by the withdrawal of the fluid. The nodular masses again become indistinct: in the course of a few weeks the abdomen has arrived almost at its former size; and perhaps before two or three months have elapsed the operation must again be performed.—It may be, that the patient still retains a fair state of general health; but if the accumulation be rapid, the system soon begins to suffer, the body to emaciate, the countenance to fade; and if pain be added, as is not unfrequently the case, when the disease assumes its more active or virulent forms, the suffering of the patient greatly reduces her strength.—The interval between the operations becomes less; and at length, after the lapse of an uncertain number of months or years, she dies, worn out. Or, on the other hand, if the suffering continues comparatively little, and operation after operation be borne without a visible decrease of bodily power or mental energy, yet, at length, some inflammatory process, apparently accidental, or some state of unexpected collapse for which no reason can be ascribed, takes place, and the patient sinks. To assign any precise or specific time to the course of this disease, from its first appearance till its fatal termination, is impossible, the difference in this respect being great; but, from what I have myself observed, I should be inclined to state, that cases which continue above four years, from the first necessity for the operation of paracentesis, bear a small proportion to those which prove fatal before that time.

Such is the more general course of this disease: but there are cases in which the latter part of the history is considerably varied; as, for instance, we find some, in which, from various circumstances, no attempt has been made to relieve the distention by operation; and then death usually follows, by the slow exhaustion of the powers of life, through irritation, or through the obstruction which the pressure of the tumor occasions, interfering with the various essential func-

tions, and sometimes by compressing the lacteals, positively
cutting off some of the avenues by which nutriment is con-
veyed to the system. Other cases there are, where nature
performing the work which is more usually attempted by art,
adhesions take place, and the fluid is evacuated through the
intestines—the orifice remaining open, or being easily re-
newed; and a gradual decline of powers leads to the fatal
termination. In some cases, the cyst, through accident, or
through a process of ulceration commenced in the inner
lining, bursts into the peritoneal cavity; and then death some-
times speedily follows, either by the effects of the shock, or
by inflammation and its results; or, occasionally, recovery
seems most unexpectedly to follow. Too often, however, the
improvement is but for a time; and the disease returns, under
still less favourable circumstances than before the rupture.
In some cases, after the performance of paracentesis, the
wound refuses to close; or bursts out afresh, and sometimes,
for months or years, a discharge continues; and this event
may not be peculiarly prejudicial, but rather serve to prolong
the patient's life. Such, then, with various modifications, is
a short history of the disease of which I shall now proceed to
give a few cases: and in the following details, I intend to
illustrate many of the circumstances I have stated, and to
bring into view the nature and extent of the structural
changes by which the disease is marked; commencing by
saying a very few words on those cases of ovarian tumor
which are probably devoid of a malignant character.

The cases to which I am able to refer with certainty, as
those where the simple serous cyst has occurred, are all of
them instances in which it has attained a very small size, and
has not been discovered during life. The patients have been
of various ages, and in various conditions; and all the circum-
stances of their cases have appeared so little connected with
the existence of the cyst, that it is quite unnecessary to detail
them. I shall simply mention two: one, on account of the
tender age of the subject; and another, from its connection
with other evidences of irritation in the uterine appendages.

Case 1.

I was, during the last year, called upon to attend an infant of five months of age; in whom, from the symptoms, scarcely a doubt existed that the obstructed condition of the bowels depended on some mechanical cause, and this we believed to be intus-susception. The child died on the following day; no relief having been obtained to the obstinate constipation under which it laboured. After death, our conclusions were verified to the fullest extent; for we found the whole cæcum and the arch of the colon, and a portion of the ileum, swallowed up by the descending colon.

All the other organs were in perfect health; but from the appendages of the uterus on the left side we discovered a cyst of the size of a pea, hanging by a footstalk half an inch in length.

Case 2.

A young woman, about eighteen years of age, died, worn out with chorea.

"The uterus was rather large, and its cavity was extensive: in the left corner was a deposit of as much clear transparent mucus as would cover a sixpenny-piece. The ovary of the right side contained a cyst of the size of a small hazel-nut, full of a tenacious dull-red substance, of just sufficient consistence to allow of being cut. The Fallopian tube on the same side was quite pervious, admitting of the passage of air from the blow-pipe; but it presented a remarkable appearance, having the points of the fimbriated extremities tipped with deposits of semi-transparent bone, looking like large grains of sand of irregular and rather botryoidal form; and a deposit of the same kind was found on the outside of the broad ligament. The ovary on the opposite side was more healthy, but had in it a few vesicular bodies. The Fallopian tube on that side had none of the bony deposits. Attached to the ligaments of the uterus, on each side, was a small vesicle of the size of a pea, hanging by a peduncle, along which vessels were seen to pass from the peritoneum."

Having mentioned these two cases, I may simply refer to what I have said in page 180; where, likewise, will be found

a few observations on another form of simple cyst when it is sessile, or developed, apparently, beneath the peritoneal covering of the broad ligament and the Fallopian tube; as, likewise, some reference to the cysts which are formed by the dilatation of the Fallopian tube itself.

————

With regard to the simply distended Graafian vesicle, without malignant tendency, the cases which have occurred to my observation scarcely go further than to throw an air of probability on the occasional existence of such diseases. There is nothing like a convincing anatomical demonstration of the point: and in the very next case, I shall relate, what I consider, partly from the analysis of the fluid contained, and partly from its structure, to be an early specimen of the malignant disease; though the cyst appeared, when viewed externally, so completely to arise in the situation of the Graafian vesicle, to be so simple in its structure, and to be connected with so healthy an appearance of the ovary, that I at first considered it a simple non-malignant ovarian cyst. It is therefore my intention not to separate such doubtful cases; but rather to introduce them in the following collection, with such remarks as will shew the reasons I may have for supposing it probable that they were of one character or the other.

CASE 3.

Incipient Ovarian Dropsy, probably of a malignant character.

S——— P———, aged 37, was admitted, under my care, into the Clinical Ward, Nov. 1, 1837, labouring under ascites and anasarca. In the preceding August she had been delivered of a female child; and immediately afterwards, profuse flooding followed, which was suppressed with difficulty: and about one week after she rose from her bed, her legs began to swell; and in less than a month her abdomen also swelled: since that, she had suffered from palpitation of the heart on exertion, and from prolapsus uteri. The fluctuation was very distinct in the abdomen, at the time of her admission. The urine was not coagulable, and varied from one pint to two and a half.

After being in the hospital nearly three weeks, she was suddenly seized with hemiplegia, and entirely lost all power over the right arm and leg; and was unable to articulate a word.

About six weeks after the hemiplegic seizure, when the
ascites had almost disappeared, but the paralysis remained
nearly unaltered, she was discovered one morning to be in-
sensible, her eyes fixed and turned upwards, with her breath-
ing somewhat difficult; and in two hours after she died.

SECTIO CADAVERIS.—Some serum under the arachnoid.   The
whole anterior lobe of the left hemisphere of the brain was re-
duced to the consistence of a custard; so that it was only kept
in its situation by the membranes, and the cineritious sub-
stance, which was of a yellow colour.   This softening included
exactly the corpus striatum and the anterior lobe.   In the
posterior part of the corpus striatum, the most material mis-
chief seemed to have taken place; and there was a small
yellow stain, as if from a slight effusion of blood some weeks
previously.   The heart was small and weak, and perfectly
adherent to the whole pericardium.   There was fluid in both
cavities of the chest, of which some was evidently of long
standing.   The uterus was healthy.

One of the ovaries presented a beautiful specimen of the
incipient stage of ovarian dropsy.   A small semi-lobulated
cyst seemed to proceed from the ovary; being completely
covered by the tunic of the ovary, so as to form, apparently, a
continuous portion of that organ.   Its size was about that of
a small hen's egg; and vessels proceeded from the ovary over
its surface. (Plate II. Fig. 1.)   The investing tunic of the
ovary could be traced to some distance over the cyst; and
then became lost in its parietes.   These parietes were about
as thick as two or three folds of writing-paper; and when
the cyst was opened, the external lobulated appearance was
found to depend, not on the existence of separate cysts, but to
be the result of bands or folds which formed one or two im-
perfect septa.   A few vessels were seen in the inside of the
cyst likewise; but whether these belonged to the inner surface,
or were seen through from without, was not quite decided
(see Plate II. Fig. 2).   When opened, the fluid it contained,
which was clear, limpid, and slightly mucilaginous, was care-
fully collected; and Dr. Rees undertook the analysis; which
will be found to correspond very closely with other analyses
in this paper, of fluids taken from malignant ovarian tumors.

" MY DEAR SIR,   " *Guildford Street, Jan.* 11, 1838.

" I inclose the account of the fluid from the cyst developed in the ovary. It is very different from serum of blood; containing no extractive soluble in alcohol, and no alkaline phosphate.

" *P.S.* I experimented on 400 grains, and have given the result in 1000 parts.

" Yours very sincerely,

" G. O. REES."

ANALYSIS OF A FLUID FROM A SMALL CYST IN AN OVARY.

Water	940.10
Albumen . . { with traces of fatty matter of the blood, and phosphate of lime }	47.75
Albumen, existing in solution as albuminate of soda . . .	6.69
Chloride of sodium	3.76
Carbonate of soda, with traces of sulphate	1.70
	1000.00

This fluid was alkaline, producing a permanent effect on reddened litmus. Its specific gravity was 1018.2. Water being 1000.

There was the distinct appearance of a diseased and thickened Graafian vesicle in the same ovary; while in that of the opposite side four or five similar bodies were seen.

From the circumstance of this cyst being developed so completely beneath the peritoneal tunic of the ovary, and from other Graafian vesicles being enlarged both in this and in the opposite ovary, I was at first inclined to consider this a case in which a collection of serum had taken place in a Graafian vesicle, in contradistinction to the more ordinary form of ovarian disease: but the analysis of the fluid leads me to a contrary conclusion; and the structure of the cyst, though simple, bears very much the appearance which is occasionally presented in certain portions of the complicated cysts: so that this case somewhat adds to the doubt I have already expressed, of having met with any very distinct case of dropsical accumulation in the Graafian vesicles, as distinguished from the disease which runs into the malignant ovarian tumor. Considering this, then, to be, as I believe it is, an example of a very early stage of the

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malignant ovarian dropsy, I introduce it here; and may just
notice, that in the case of Maryett (Case 17), an instance of a
still more early and partial development of the disease will
be found associated with extensive and well-marked disease
in the ovary of the other side. And, as I conceive this
to be the incipient state of the disease in its mildest cha-
racter, I shall follow it by a case somewhat more advanced,
and differing in some respects, which well illustrates the
connection between the class of diseases which we are con-
sidering, and the truly malignant action going on in the
system. The following case I have taken from the register
of Guy's Museum; and in Plate X. Fig. 5, will be found
a reduced sketch of the ovary and uterus, as they are still
preserved.

<div align="center">

CASE 4.

*Diseased Ovary, with Cysts, in a case of extensive malignant
disease of other organs.*

</div>

ANNE COPELAND, aged 48, admitted 30th August, 1830, into
Dorcas's Ward, under Mr. C. A. Key, for scirrhous mamma.
Her health was not then much disordered; but the existence
of several hard subcutaneous tumors, of various sizes, about
the abdomen, and the discovery of similar disorganization in
the liver, marked the extensive nature of the disease. Her
principal, and almost only complaint, was of pain in the right
side. She sunk gradually on the 13th, having exhibited no
remarkable symptoms.

SECTIO CADAVERIS.—The body had undergone much cada-
veric change: it was not emaciated. A hard scirrhous mass
occupied the situation of the left mamma: the right was
slightly affected in the same manner. The tumors beneath
the skin had the appearance of diseased absorbent glands:
sections of them shewed, in all, the same scirrhous structure.
The chest contained about two pints of serum, rather turbid,
and much tinged with blood; probably the result of cadaveric
transudation. The fluid in the pericardium was about two
ounces in quantity, and also very much tinged. That in the
abdomen was small in quantity, and of a reddish-brown
colour. Well-developed tubera, of scirrhous character, from

the size of a walnut downwards, were found in great numbers in the liver. The smallest and latest formed of these had the appearance of round, flat, circumscribed opaque marks on the surface of the viscus: the larger ones were flat externally, or depressed in the centre. Small bodies, of a scirrhous character, were thickly dispersed throughout the omentum and mesentery, and other parts of the peritoneum; but none of a large size. Both ovaries, the right in particular, were much enlarged and indurated, their surfaces being very irregular: the Fallopian tubes, however, seemed free from disease. The body of the uterus contained a tumor the size of an egg; but the surface of the organ was sound, as were also the os tincæ and vagina. No unnatural appearance of the peritoneum had taken place in any of these situations. The pleuræ were partially connected by old adhesions. A few marks were found on the surface of the heart and of the spleen, resembling the commencement of disease as described in the liver. On the lungs these were more numerous; and in some few had acquired a consistence resembling cartilage. The substance of the pancreas and spleen, the kidneys, with their tunics, and the brain and its membranes, were healthy. No fibrin or coagulum was found in the heart or in the large vessels: these last were stained of a red colour. All the tissues had undergone much softening. The right ovary was about three inches and a half in its largest diameter: it was much corrugated, and raised into irregular elevations on its surface; and when cut into, shewed a most diseased structure throughout; the section laying open five or six vesicles, each approaching the surface, and about the size of a large hazel-nut, filled with fluid. These appeared to be Graafian vesicles; but the whole structure of the ovary was a mass of hard, malignant disease. (Plate X. Fig. 5.)

This case serves to shew the connection between the cystiform enlargement of the ovary and malignant disease, which developed itself in various parts of the body in the form of scirrhus, and in the uterus, probably, as the fibrous tubercle.

CASE 5.

Ovarian Dropsy of eleven years standing.—Death probably from inflammatory changes going on in the interior of the cyst.

ESTHER WAITE, a woman of light sandy complexion, was first admitted under my care, Sept. 8, 1824; when her age is set down at 27, and she stated she had then been ill for a period of nine years. Her general appearance was that of a woman some years more advanced in life than this statement would point out; but if correct, she must have begun to feel her present disease at the age of 18. It is certain, that nearly two years before her admission, that is, in May 1822, the operation of paracentesis had been performed, and a quantity of fluid, amounting to two pailsful and a half, or about five gallons, had then been drawn off;—nearly an equal quantity had been taken away in June 1823—the same quantity in December of that year—and in February and June of 1834.

At the time of admission, her abdomen was generally and greatly distended; and, on even a superficial examination with the hand, three or four large masses were to be felt; which, from the situation they occupied, were considered by some to be probably enlarged viscera, as the spleen and liver: however, a more attentive examination, together with the history of the case, easily explained their nature and situation; for there could be no doubt that this was a case of ovarian tumor, and that these were subordinate cysts growing into the cavity from the parietes of the larger cyst. Her general health was suffering somewhat, from the pain she occasionally experienced in the abdomen: I therefore ordered her to be tapped; and sixteen quarts of thick opaque fluid were taken away, with great relief: and when the abdomen was examined, the hard masses were felt even more distinctly than before. After a short time she left the hospital; but returned in February 1835; on the 18th of which month, twenty quarts of fluid were taken away: on the 9th of April, twenty-six quarts were drawn off: on the 5th of July, sixteen quarts: and on the 8th of November, sixteen quarts and a half: at the next operation, seventeen quarts and a half: and at the next, twenty-one quarts were removed, on July the 10th, 1836. Again, in October 1836, twenty-two quarts were taken; and in the end of

January 1837, an equal quantity. The last two or three operations had been attended with more inconvenience than the former, and the fluid had become more puriform in its appearance; and a sense of sinking and lowness, with tenderness and abdominal pain, bespoke mischief, probably of a low inflammatory character, going on. All these symptoms became aggravated after the operation in the end of January; and on the 8th of the following month she gradually sunk.

Thus, during a period of between four and five years, this patient had been tapped fourteen times; and in that space had lost sixty-eight gallons of the thick glutinous fluid characteristic of this disease.

SECTIO CADAVERIS, *Feb.* 9, 1837.—The general aspect greatly emaciated: no œdema in any part: the abdomen very large, but not distended, appearing quite flaccid. On opening the abdomen to the left of the umbilicus, nearly a bucketful of turbid yellow fluid, resembling pus in appearance, and just like that which had come away by tapping, was removed. On making an opening at the scrobiculus cordis, in the direction of the linea alba, another cavity shewed itself also, containing a fluid not very different, though somewhat less turbid and thick than that in the chief cavity. About two full wash-hand-basins of fluid were taken from this cavity.

On further examination, it appeared that the first cavity opened was the chief cavity, and that from which the fluid had always been drawn by tapping. It was a completely encysted cavity; whereas the other portion of fluid was contained in the cavity of the peritoneum itself. With respect to the encysted cavity, it appeared, on minute examination, that it was a large cyst, arising from the situation of the left ovary, and having the Fallopian tube of that side greatly elongated (not less than eight inches in length), attached along its outside; the fimbriated extremity being plainly seen at the end.

This cyst was attached most firmly and generally to the anterior parietes of the abdomen, so as to require careful dissection to detach it. It was thicker and stronger towards

the left side, and in front; but was rather thin towards the right side and in the iliac region. It had formed no attachments to the viscera, except that at the upper part it was glued to the omentum: it quite filled the cavity of the right ileum; and the intestines were very much pushed aside by it towards the left side.

Internally, the cyst was very vascular, and was covered, in patches, with a deposit of puriform lymph of a yellowish-green colour; while in many parts it was rough, as if ulcerated. In other parts, tuberculated masses of different sizes were seen: of these, two were more remarkable; the one occupying a situation a little below the spleen, and the other a little below the liver, between the right iliac and lumbar regions: and as these were, in parts of the cyst, closely attached to the parietes of the abdomen, they had been perfectly discoverable by the touch for the last two years, and did not change their position in the least at the time the fluid was drawn off: besides these two large masses, there were four or five others, smaller in dimensions, attached to different parts of the cyst; one, which had been always felt about an inch above the umbilicus.

. The smaller masses were like small thick cysts: and one of the smallest being opened, it was found filled with a straw-coloured substance, semi-transparent, of a glutinous character; which separated with some difficulty from the sides of the cavity, and then disclosed another cyst of a more rounded form, semi-transparent, and beautifully vascular. (Plate IV. Fig. 1.) This appeared to be the more early stage of each mass—these internal cysts sprouting up from the bottom, and bursting the external cysts; and then the surface, so opened, becoming a secreting surface of that semi-gelatinous matter, which, in its more diluted form, seemed to compose the fluid which had been so frequently drawn off by tapping.

On examining one of the larger masses, the cyst, out of which the tubercular-looking growth had proceeded, was seen opened, forming a margin round about two-thirds of the mass: the other third became lost in the tubercular cysts: the internal lining of this was in the highest degree vascular. These cysts rose almost like a cauliflower-head, quite opaque and vascular; and one mass, which was more advanced, shewed, on the surface, an appearance of irregularly-deposited

lymph. (Plate III.) Each of the masses, on examination, shewed the same structure, with some variation: in some, the cysts were full of fluid or semifluid matter; while in others they were hard, and presented various approaches to the true malignant character.

The uterus, the right ovary, and the Fallopian tubes, were perfectly healthy.

The liver was pushed up to the diaphragm; and, having formed strong adhesions, remained in that situation when all the other abdominal contents had been removed; its lower surface apparently occupying nearly the natural position of the diaphragm itself. It was much enlarged, of a yellow colour throughout, and firm consistence, approaching to the udder liver. The gall-bladder was filled with a full-coloured and apparently healthy bile.

Spleen quite healthy. Stomach quite healthy, internally and externally, but containing a quantity of dark matter. Intestines throughout healthy externally; but through a considerable portion of the ileum, some feet in extent, the solitary glands were enlarged, and their orifices tinged with yellow, so as to give the appearance of pretty thickly disseminated yellow specks: this appearance diminished as you approached the jejunum. Colon healthy. Kidneys pallid in colour; and the tubuli uriniferi appeared blocked up with little concretions or sandy deposits. Heart rather feeble. Lungs most perfectly healthy throughout, without the least adhesion.

This case may be considered as presenting a well-marked example of the complicated ovarian tumor, which had proceeded through many years in the successive changes of its growth; and I give it as a fair specimen of a large class of such cases.

CASE 6.

Ovarian Dropsy, Anasarca, and Ascites.—Death from Peritonitis, after the fluid was partially drawn from the cyst.

ANNE MARSHALL, aged 34, was admitted, under my care, into Guy's Hospital, March 25, 1829, affected with ovarian dropsy, anasarca, and ascites. Her abdomen was more distended than I ever before witnessed; so that it hung over the thighs, chaffing the groins; and the umbilicus was scarcely to be seen:

it measured, on its most prominent parts, four feet ten inches in circumference: the cutaneous veins were very much distended, and fluctuation very distinct in the upper part of the tumor; but below the umbilicus the whole was hard, lobulated, and unyielding.   Her general health was represented as pretty good, but she had lost flesh within the last two months: her countenance was placid: tongue clean, but purplish; and the respiration much impeded when in the recumbent posture.   Pulse 120, rather weak: urine scanty, of a dark colour, tinged with bile, and having a light-reddish sediment, not coagulable by heat.

Eighteen months ago, she lay-in, having been extremely large during her pregnancy, and after her confinement never diminished to her usual size.   A month afterwards she was tapped in the usual place, rather below the umbilicus, but not more than a quart of yellow gelatinous matter came away.   The catamenial discharge occurred quite regularly till three months ago, since which it has ceased; and it is only for the last two months that her urine has been scanty and high-coloured.

She took medicines, gently to regulate her bowels, and to act on her kidneys, till the 15th of April; when having had a consultation with other medical officers upon the subject, and perceiving that the abdomen increased, and the breathing had become so impeded that she was constantly obliged to sit erect in her bed, I recommended paracentesis.   As there was no fluctuation to be felt below the umbilicus, it was judged right to make the opening some inches above it; and fearing the effects of the large depletion, the canula was withdrawn, when eleven pints of a coffee-coloured fluid had been extracted.

16th.   She was quite comfortable, and free from all pain: and she remained so well till the 22d, that we were already beginning to consider at what time the remainder of the fluid might be drawn off; but her nights now became restless, though she denied all pain; her breathing became shorter; and she felt generally worse.

24th.   Pulse, feeble, 140: respiration 40: hands clammy: no tenderness on pressure of the abdomen, unless it be very heavy just below the scrobiculus cordis.   She vomited once in the

night. The abdomen was covered with a large mustard
poultice, and simple injections administered. The next day
she seemed relieved, but gradually sank; the tongue becoming
dark; and she denying, to the time of her death, that she
suffered any pain.

SECTIO CADAVERIS, *April* 26, 1829.—The distention of the
abdomen was very great, and the recti muscles were spread
like a panniculus carnosus, over 'the abdomen. A punc-
ture being made, above two pailsful of green fluid were
drawn off, turbid, and containing some shreds of recent coagu-
lable matter: the parietes were then laid open; and were
found to be adherent, in some parts, by tolerably firm
adhesions to a large sac, which now appeared to occupy
the whole abdomen. The viscera were all thrust by this
so far upwards, as to lie within a line drawn across from
one false rib to another. The colon was seen of a black
colour, projecting at the top, greatly distended with flatus,
and looking like another large cyst. The whole of the
cyst was covered with shreds of lymph, shewing recent
inflammatory action; and the colon was glued to the cyst,
to the liver, and to the stomach. When these adventitious
unions were broken down, the whole of the small intestines
were found closely compacted together below the inferior
part of the colon, and the cysts united to each other by a dark
grey or black fibrinous deposit. The cyst was separated
with tolerable ease from its attachments; and was held
only by the round ligament of the uterus. Its coats were a
quarter of an inch thick; and it contained several pints of
grumous brown fluid; and around the sides was deposited
a light-brown fibrous matter, like the fibrin separated
from the blood; masses of which came away from cells
connected with the larger cyst, and opening into it by well-
defined crescent-like openings, of which the edges were entire.
Some of these cells were capacious enough within to hold a
quarter of a pint of such soft fibrinous matter; and when it
was emptied out, several globular transparent cysts came into
view. On the lower part of the tumor, turned towards the
pubes, was situated the chief mass of globular cysts. These
were situated completely between what appeared to be the

laminæ of the membrane composing the large cyst; and were freely supplied with vessels from it. When this was cut through by one clean incision (Plate V.), several tumors were divided, and found to be full of a yellow glairy fluid, something like oil, while others remained perfect; and some crescentic margins or bands were seen, which had half divided the cysts, laid open. A few very small cysts were seen sprouting out of the parietes; and a very peculiar structure, like a network of fibres, from beneath which the cysts were in some parts seen sprouting, as if forcing open and distending the meshes. (Plate IV. Fig. 2.)

The whole of this diseased mass was in the exact situation of the right ovary, and appeared to be formed by a gradual distention of the broad ligament at that part, in such a way, that the Fallopian tube was bound round it; and the covering of the tumor was, to all appearance, a continuance of the covering of the ovary, very much thickened; the ovary itself being quite lost in the mass.

In this case, the whole bore the appearance of having been the result of a disease in the ovary itself; the cells of which had been distended by an enormous secretion within them; and the reticulated parts seemed to be little other than the cellular membrane of the part thickened into cartilaginous bands.

The immediate cause of death was the extensive peritoneal inflammation; which, in all probability, was chiefly owing to the fluid not having been more completely emptied out of the cyst, and some of it consequently escaping into the peritoneal cavity.

Case 7.

Ovarian Dropsy of many years' duration; shewing several cysts in different conditions;—with the analyses of the fluids they contained.

Maria Norris, aged 35, was admitted, under my care, into Guy's Hospital, December 3, 1834, apparently the subject of a very large ovarian tumor: she had been married above eight years, and had borne three living children within that period. It seems to have been about the time of her marriage that she first experienced some pain and swelling at the left side of the abdomen, in the inguinal region; and the swelling

gradually increased, so much, that about five years and a half ago, it was necessary to draw off the fluid it contained, with the trochar: it then very slowly increased; and it was not till after three years and a half that a second operation was performed. The increase was then more rapid; for she was again tapped after a year and a half, which was in June last; so that less than six months have passed, and now she is nearly as large as she ever was. The abdomen is very greatly distended; and the fluctuation is very distinct in every part, even in the lumbar spaces: the body is emaciated. On the 8th, four gallons of fluid were drawn off, of a dingy colour, and containing numerous small shining flakes of what appeared to be cholestorine; and which Dr. Rees, who collected a considerable quantity of this matter, and examined it more minutely, at my request, decided to be so. On the fifth day after the operation, a brisk purge of rhubarb and calomel brought away much hardened fæces; and the abdomen being then flaccid, I examined it carefully, and plainly discovered three or four hardened bodies appended to the parietes of the cyst. The urine was sufficient in quantity, light-coloured, and not coagulable. Within a fortnight, the fluid had obviously accumulated considerably; but her feelings being very comfortable, she wished to return home about three weeks after the operation.

Aug. 12, 1835. She was again admitted, under my care; being as large as before the last operation, but suffering less from sickness, dyspepsia, and general symptoms of oppression, than has usually been the case. On the 14th, four gallons and a half of fluid, moderately coagulable by heat, were drawn off; after which she suffered some pain and tenderness, with a quickened pulse, requiring leeches, and calomel and opium, for a few days, till the gums were very slightly affected.

The two most obvious hardened masses were to be felt: one, low down on the right side; the other, above the umbilicus, to the left. (Plate I. Fig. 1.) She remained in the house till the 14th of September; when, although the fluid was again accumulating, she preferred going home to her family.

March 9, 1836. She was again admitted: and on the 15th, twenty-five quarts of fluid were drawn off; after which, the

two tumors, which had been before felt, were very distinctly found. In about three weeks she left the house, but the fluid was again accumulating.

Aug. 3. Again admitted: and the following day, five gallons and a quart were again drawn off; which she bore without any unpleasant symptoms, and returned home in about a fortnight.

Nov. 15. She was again admitted: on the 25th, twenty-four quarts of fluid were drawn off: it was of a darkish colour, with some ropy sediment, and tinged with some red particles. On the 12th of December she returned to her family.

March 22, 1837. She was again admitted: and, again, about the same quantity of fluid was drawn off, on the 30th. On the 5th of April shivering took place, accompanied by swelling, apparently glandular, in the pelvic and inguinal regions, which required a good deal of attention and treatment: however, on the 15th of May she left the hospital, in her usual state of health.

Maria Norris (now called Price, having lately married again) was admitted, under my care, July 26, 1837, with the abdomen again distended to the utmost; and complaining of sickness, for which I gave the hydrocyanic acid.

On the 31st of July, when the sickness had subsided, and the bowels were opened, twenty-three quarts of serum were drawn away, of a muddy colour, slightly oleaginous, and moderately coagulable by heat: after this, considerable inflammation took place, which was subdued by calomel and opium; but it was three weeks before she was able to return home.

In this case, we observe a disease which, in all probability, depends upon a structural change in the ovary, very similar to that which was discovered in Waite; proceeding, as yet, in a comparatively mild course. That the tumor consists of a large sac, in the parietes of which hardened enlargements are developed, scarcely admits of a doubt; but though the secretion seems to proceed with an accelerated progress, we have reason to believe, from the character it bears, that the surface of the cyst has not yet undergone these changes from the bursting of the smaller cysts, which are apt to produce

the still more irritating or less mild character in the dis-
charge. It is, however, but too obvious, that the disease is
now making inroads upon her constitution; and that the
symptoms which have attended the two last operations have
been more alarming than on former occasions. Up to that
time she suffered scarcely any pain from the disease, or any
unpleasant results from the operation: indeed, the increasing
bulk of the tumor has been almost the only source of incon-
venience; and no less than nine years and a half have now
elapsed since the swelling was so large as to require the first
operation, but the disease has certainly existed between
eleven and twelve years. The form of this tumor is highly
characteristic of an encysted accumulation of fluid; so that
I have had it engraved (Plate VI.) as an example of that form,
from a sketch which was taken two or three years ago; and
the patient is still able to lie recumbent on her back, as here
represented, without suffering from dyspnœa even when the
accumulation is at its utmost. The only alteration I have
had made in the sketch, is strengthening the appearance of the
superficial veins; which remain nearly the same in distribu-
tion, but are more distended.

Thus far I had written this case, and prepared it for
publication, when, on the 13th of December 1837, the subject
of these observations again applied for admission under my
care: but her appearance was dreadfully changed; she was
greatly emaciated; her voice was feeble; her eyes sunk; her
pulse was extremely weak; her bowels were in a state of
constant irritation; and her stomach was unable to retain
the least food. The form of the tumor, however, was nearly
unaltered; but a little more pendulous in the lower part, as
she lay on her back; and the veins on the surface, though
almost exactly the same in distribution as had been marked
in the sketch, were become larger and more obvious; and in
some parts, owing to the thinness of the skin, from which
every particle of adipose matter had been absorbed, they
seemed to have communicated a stain around them by trans-
udation, producing a kind of ecchymosis. The tumor was
about the size which it had reached before the former opera-
tions, and the fluctuation was remarkably distinct in every

part; nor did any part yield a clear sound on percussion, though a small space in the left lumbar region was rather more resonant than the rest. I learnt, that the operation of paracentesis had been performed at her own house in the end of October, just five weeks before; and that three pails-ful, certainly amounting to four or five gallons, had then been drawn off: but she had never left her bed till the day she came to Guy's Hospital; and had, for the last three weeks, been subject to constant diarrhœa. By means of gently astringent injections, the bowels became less irritable, and her stomach was enabled to retain some small quantities of nutriment; so that, for a day or two, she left her bed, and sat by the fire-side. She strongly objected to having the operation performed: nor could I, in her present emaciated and en-feebled state, press it upon her; though I had no doubt that, if she bore the operation, she would derive much temporary relief. The amelioration of her symptoms was but of very short duration. The diarrhœa returned, and, with it, in-creased irritability of stomach. She suffered considerable pain, particularly in the right side, where tenderness was experienced. Such palliative means as appeared admissible were assiduously administered; but she sunk on the night of the 7th of January.

SECTIO CADAVERIS.—The integuments were reduced to their utmost tenuity; and were in many parts so closely adherent to the sac of the tumor, that the thickened peritoneum seemed to split into two layers, in the attempt to remove them. When the tumor came into view, it appeared to occupy the whole space of the abdomen, forcing the ribs up, so as to give the chest a bell-like form. (Plate VII. Fig. 1.) The adhesion of the cyst was chiefly confined to its anterior part; and a slight evidence of recent peritonitis was found in the right lumbar space. When the tumor was removed, it was found to be appended to one ovary alone, which was considered the right; though from the twisted position of the uterus, I was not quite convinced that it was. The other ovary was small and dwindled. The tumor did not adhere to any of the viscera, except partially to the omentum; which came

into sight on opening the integuments, spread over a small
extent of the upper part of the tumor.

The liver lay closely driven up into the hollow of the
diaphragm, encroaching on the chest as high as the fourth
rib; and being slightly adherent, did not come into view,
even after the tumor was removed. (Plate VII. Fig. 2.) The
stomach, and the whole of the intestines, except the descend-
ing colon, were pushed likewise into the hollow of the
diaphragm, and were exceedingly contracted; so that alto-
gether they seemed to bear no proportion to the enormously
increased dimension of the abdominal cavity. The stomach
was contracted to one-fourth its natural size; and the colon,
as well as the small intestine, had very nearly the same
relative dimensions. The descending colon was seen running
down, closely bound to the parietes of the right lumbar space,
and terminating in a very strongly-marked sigmoid flexure.
None of the intestines bore marks of peritoneal inflammation,
either old or recent; and no remarkable disease was dis-
cernible in the mucous membrane of the stomach, or any part
of the canal. The structure of the liver was tolerably healthy,
as was that of the spleen. The kidneys were partially ab-
sorbed, owing to the obstruction which the ureter had suf-
fered; and this was particularly the case on the left side,
where the ureter was not only dilated, but much thickened;
and the enlarged infundibula contained a puriform fluid.
The bladder was contracted.

The lungs adhered to the ribs, and were extremely small,
from the encroachment of the tumor; but were not otherwise
diseased. The heart presented a remarkable specimen of
atrophy; and the aorta, through its whole extent, corresponded
well with the heart.

The ascending cava lay quite flat and empty, and small
upon the spine: it contained neither blood nor coagula; but
did not appear diseased, nor was there any approach to
obliteration.

The iliac and connected veins contained firm coagula of
recent red blood.

The tumor itself consisted of one large cyst, which con-
tained a bucketful of rather tenacious straw-coloured fluid;
which towards the bottom became opaque and puriform. In

its parietes, towards the left side, was a large mass, like
a placenta, consisting of several semi-transparent cysts,
which yielded a very transparent gelatinous fluid, contain-
ing portions more opaque; and within the large cyst arose
two smaller ones, each containing above a pint of fluid;
one of a limpid straw-colour; the other a more turbid fluid,
loaded with little shining particles of cholestorine, correspond-
ing precisely with the fluid which had been drawn off, to the
extent of four gallons, on the first admission of the patient,
just three years ago, in December 1834.

The cyst which contained this fluid was somewhat thicker
than the large cyst; and it had undergone changes which
seemed to bespeak that, in all probability, it had at one time
been much larger than it at present was; for many plates of
a cartilaginous hardness were found imbedded in its parietes.
Its external surface looked diseased and rough, and puriform
matter was attached to it; while its internal surface was
smooth and polished, presenting a shining membranous ap-
pearance.

One of the masses which occupied the parietes of the
larger cyst had begun to sprout out, and become opaque,
yielding puriform matter, quite analogous to the change which
I have described, and endeavoured to represent by an en-
graving, in the case of Waite.   (Plate III.)

. Thus the fatal result and consequent examination confirmed
the similarity of this case to that of Waite; proving the
same changes, but rather in a more advanced degree, had
taken place in the large cyst: and the puriform matter which
had been drawn from Waite would have been exactly imitated
in this case, had the operation been performed; that fluid
being probably yielded, in part, by the fungoid mass growing
from the surface, and, in part, by the lining membrane of the
cyst in which a process of superficial ulceration had taken
place.

It was a matter of considerable interest, both with myself
and Dr. Rees—who had examined the fluid, drawn at the first
operation, performed under my care just three years ago—to
ascertain whether any of the cysts contained cholestorine in the
state we then discovered; for we had conjectured, from the
total absence of that substance in the fluid drawn on a sub-

sequent occasion, that the same cyst could never have been again opened; as it appeared very improbable that the fluid should have been so completely removed and never have formed again : and this proved to be the case; for after I had obtained specimens of the fluid from each cyst in succession, we at length (but not till the fourth cyst was opened, and I had begun to despair of finding any cholesterine) came to the cyst which contained that substance. I immediately put all the four specimens into Dr. Rees's hands, whom I knew to be sufficiently interested in the case to undertake these analyses; and of this I was 'the more desirous, in the hope that we might be able to derive some guide in our diagnosis between encysted dropsies and ascites, from the actual chemical properties, as we do already, to a certain degree, from the obvious and physical character of the fluids. How far this hope has been realized, must be gathered from the following analyses and observations.

EXAMINATION OF FOUR FLUIDS DRAWN FROM SECONDARY CYSTS OF AN OVARIAN TUMOR, AND OF ONE (NO. 5), PROBABLY FROM AN OVARIAN CYST, BY DR. REES.

	No. 1. Clear, light straw-coloured, alkaline, sp. gr. 1017.	No. 2. Dark-coloured, muddy, neutral, sp. gr. 1017.	No. 3. Approaching in character to white of egg, alkaline.	No. 4. Clear, straw-coloured, containing flakes of a pearly, scaly-looking substance.	No. 5. Sp. Gr. 1009, alkaline, very tenacious. (see Case 3.)	Analysis of serum of blood, for comparison.
Water	190.9	190.70	195.2	187.7	195.32	181.2
Albumen, with traces of fatty matter	4.1	4.25	1.8	7.6	0.54	16.5
Albumen, existing in solution, as albuminate of soda	3.7	3.62	1.1	....	† 2.22	0.4
Alkaline chloride* and sulphate, with carbonate of soda, from decomposed albuminate.............	0.8	0.78	1.2	} 4.0	‡ 1.08	1.6 ¶
Extractive, soluble in water, and alcohol..	0.4	0.45	0.5	0.5	0.54	0.3
Chloride of sodium with carbonate, from decomposed lactate of alcoholic extract ...	0.1	0.20	0.2	0.2	0.30	
	200	200	200	200	200	200

* In very small proportion, being in great part separated with the alcoholic extract.

† This albumen existed only in part as albuminate of soda.

‡ This was from decomposed lactate, with traces of phosphate.

¶ The whole of the alkaline salts are estimated together in the analysis of serum, as indicated by the line.

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It will be seen, on comparing these analyses with that of the serum of blood, that, in every specimen, there is a considerable excess of water and extractives, and a deficiency of albumen. As all these fluids were of that mucoid tenacious character so well known to those who are in the habit of examining the cysts of ovarian dropsies, I am inclined to conclude that this peculiarity in appearance is attributable to the presence of a large proportion of extractives, particularly the albumen combined with soda (aqueous extractive insoluble in alcohol); which opinion is confirmed by the experiments of Dr. Babington, who has succeeded in forming a mucoid fluid by the addition of alkalies to albuminous secretions.* If we regard the salts present in proportion to the quantity of solid matter, we shall find that Nos. 1 and 2 contain an excess of salts; for the solid matter in 200 grains of serum is equal to about 18.8 grs., and the proportion of alkaline salts 1.6; while the solid matters of Nos. 1 and 2 are 9.1 and 9.3 in 200 grains, and the proportion of salts 0.9 and 0.98; whereas their corresponding proportions would be about 0.77 and 0.79; for $9.1 \times 1.6 \div 18.8 = 0.77$; and $9.3 \times 1.6 \div 18.8 = 0.79$. My reason for regarding the salts in relation to the solid matter, is, that the peculiar mucous character of the liquors is owing to the *nature* of the solid ingredients; and quite independent of any particular proportion of water, as might at first be supposed. If No. 3 be compared, we observe a very great excess of salts in proportion to the solid contents, which are very small. No. 4 gives likewise an excess of extractives and salts taken together: the proportion of salts alone was not ascertained in this specimen, as a loss was experienced while determining their weight. The fat contained in these fluids (which was estimated with the albumen, and existed as a mere trace) consisted of the ordinary fatty matter of the blood in Nos. 1 and 2. Nos. 3 and 4 contained cholesterine, as the fat.

The flocculi of pearly, scaly matter were separated from No. 4 previous to analysis, by diluting the portion of liquor containing them with a large quantity of water, and allowing it to drain through a fine linen cloth; the residue on the filter being well washed with cold distilled water. Of this substance, 5.3 grains were obtained †: on examination, it was found to be composed of

Cholesterine 3.4
Albumino-cerous matter ‡, with traces of albumen . . . 1.9

The alkaline salts obtained from the ovarian liquids differ from those of the blood, in not containing any phosphate which can be recognised, even as a trace in the quantity of solid matter obtained from 200 grains: experiments made on larger quantities, for the express purpose of detecting

* Vide *Guy's Hospital Reports*, Vol. II. p. 534.
† From 18 ounces of the liquid.
‡ First noticed by Dr. Marcet, as existing in a diseased thyroid gland: afterwards by Dr. Bostock (who gave it the above-mentioned name), as found in tumors of muscular parts. More particularly described by Dr. Bostock, as found in a hydrocele of some years' standing.—Vide *Medic. Chirurg. Transact.* Vols. II. IV. and XV.

It may be well to mention, that this substance differs from albumen in not being soluble in a solution of potassa, and from cholesterine by its insolubility in boiling alcohol. It otherwise closely resembles cholesterine in its chemical properties.

an alkaline phosphate, shewed a trace only.—I may observe, that the albumen from these liquids yielded a scarcely perceptible portion of earthy matter on incineration : this, most probably, was phosphate of lime*.

The proportion of water and solid matter in No. 5, approaches very nearly to that of No. 3. It contains much less free albumen, however, and more albumen in combination. I have no doubt that many alkaline salts, as well as any free alkali present, have the power of retaining albumen in a soluble form after a heat of 212° has been applied to dry it; for the salts, from the aqueous extractive in this specimen, yielded less carbonate than did that of No. 3, notwithstanding the excessive proportion of combined albumen. I am inclined to attribute much of this solvent power to the lactates, which exist in greater proportion in this specimen than in any of the kind that I have yet examined.

Case 8.

Malignant Tumor in Abdomen, probably Ovarian—discharging constantly from the wound made by Paracentesis.

E—— D——, aged 34, ill six years, of moderate stature, dark hair and eyes, single, and employed as governess in a family, was admitted into Guy's Hospital in Feb. 1838. Between her sixteenth and seventeenth year the catamenia first appeared, and have continued, at the proper times, till within the last four years, since which period they have appeared irregularly. She says, that she has not enjoyed good health for many years past, having had repeated attacks of inflammation of the bowels, head, and chest. About six years ago, one month after the last severe attack of inflammation of the bowels, she first perceived a general swelling over the inferior half of the abdomen, apparently commencing rather above and to the left of the umbilicus. This gradually increased in size downwards; and after two years had elapsed, paracentesis was performed, and six and a half gallons of glutinous fluid, of the colour of mustard-whey, were drawn off. Two months after, the abdomen again enlarged; and about one pailful was discharged through the former opening, which gathered, and burst of its own accord. A few months after, an abscess formed at the opening, which burst, and discharged to the amount of a wash-hand basin; since which, although there has been a constant discharge, the abdomen has enlarged, the superficial veins are distended, and the umbilicus is entirely obliterated.

* The analysis of specimen No. 5 was performed after these observations were written.

The parietes of the abdomen are not at present (March 1838) greatly distended, but the skin feels flaccid under the hand : the chief prominence is around the umbilical region ; but the tumor may be traced into the left iliac fossa, and into the pelvis on that side : no fluctuation, or very little, is to be felt. The tumor is hard to the feel, and irregular on its surface, and appears glued to the parietes. In the situation of the puncture made by the trochar, a vascular excrescence arises, of the size of a small bean ; from beneath which a fluid distils, so as to keep the napkin constantly moist : it is clear, and slightly mucilaginous ; and, according to the analysis of Dr. Rees, to whom I gave some, which she collected for me in a phial, it agrees very closely with the fluid con- tained in the ovarian cysts. (See Table No. 5, p. 209.)   She says that the tumor has decidedly diminished latterly ; and her health is tolerably good, with the exception of occasional vomiting. Tongue clean, pulse feeble, appetite good ; but she has emaciated lately, and complains now and then of pain in her loins.

The whole history of this case seems to bespeak a malig- nant ovarian cyst, which has formed adhesions to the parietes, followed by a fistulous opening externally ; and, judging from her present condition, her capability of walking about, her general manner, and aspect of tolerable though weak health, there seems little reason to doubt, that this circumstance has conduced both to her comfort and to the prolongation of her life.

CASE 9.

Compound Ovarian Cyst—death from exhaustion.

SUSAN WEBB, aged 25, was admitted into Charity Ward, July 14th, 1830, the subject of ovarian dropsy, for which she had already been twice tapped. Her abdomen was very large, and she had a red sandy complexion ; and although not under my care, she struck me immediately, from her strong re- semblance to my former patient Waite (Case 5) : and when I examined her abdomen, the similarity was still more striking, for in different parts of the large fluctuating tumor other small irregular hard tumors were distinctly felt. Her health appeared good, except so far as the size of the abdomen

interfered with it. She was three times tapped when in the house, and bore the operation well: a large quantity of thick glutinous fluid was drawn off each time. The last operation took place on the 9th of November: she seemed very well for a day or two; but about ten days after, without any very obvious cause, became exceedingly exhausted, and died on the 23d of the same month.

SECTIO CADAVERIS, *November* 24, 1830.—On opening the abdomen, the cyst, which had been tapped, occupied the lower part, pushing the intestines to the left side; while a large growth from the tumor appeared like an independent body in the right side, pushing the liver upwards. This upper portion of the tumor was divided into several lobules; and a few serous cysts were hanging from it.

On carefully examining the attachment of this diseased mass, it was found to arise entirely from the situation of the left ovary. The Fallopian tube on that side was stretched over it to a considerable length, and the uterus was a little drawn from its place. No adhesion had taken place to the parietes, and only a few slight filamentous attachments to the omentum.

When the large cyst was laid open, three or four pints of fluid escaped, which was like thin water-gruel in consistence, but a little more mucilaginous; and in two or three parts, when the fluid was completely removed, subordinate tumors were seen rising from the lower part of the cyst. In several parts the lining membrane was evidently undergoing a process of softening, or a kind of sloughing, so as to allow of the protrusion of small cysts through orifices which were then surrounded by marginated bands circular or crescentic, the central softened portions of such parts of the cyst being yellow and friable: and when removed, a quantity of thick mucus, like birdlime, issued from the orifice.

There was not more than half a pint of fluid in the abdominal cavity, and no evidence of recent inflammation. The absorbent glands along the course of the left iliac vein, near its exit, were enlarged; which seemed to account for a considerable swelling, during life, in the leg and thigh of that side.

This case, which is one of well-marked malignant disease of the ovary, proceeded rapidly, so that paracentesis was

required no less than three times in the space of four months. It is chiefly valuable, as shewing one of the circumstances which occasionally occurs, perhaps as the result of operations (but even that is uncertain), where an almost sudden and unexpected state of exhaustion or collapse takes place, and death ensues without any obvious sign of inflammation being observed afterwards, except that which may be supposed to have been taking place in the interior of the cyst itself.

The appearance of the interior of the large cyst illustrated very strikingly the same process in the development of the small cysts, through openings taking place in the membrane, and leaving crescentic margins, as in the case of Waite (Case 5. Plate III.); or in that of Marshall (Case 6. Plate IV.); an appearance which possibly results from the original cellular structure of the part.

Case 10.

Compound Ovarian Cyst—the fluid never removed—slow exhaustion, and death—adhesions of the tumor to the parietes discerned during life.

The following case has been already published, in a paper treating on the subject of peritoneal adhesions, in the Transactions of the Royal Medical and Chirurgical Society; but as the case involves the history and termination of ovarian dropsy when no operation has been performed, and as the illustration it affords of the means of diagnosis in cases of adherent peritoneum is necessary for the completion of the present subject, I think it well worth introducing in this place.

Sophia Young, aged 30, was admitted, under my care, into Guy's Hospital, Feb. 24th, 1830, with a large swelling of the abdomen. She had borne five children; and since August, the catamenia had not appeared till three weeks ago, when there was a slight appearance; and at the time of her admission she laboured under menorrhagia. The tumor occupied the whole abdomen, and was of a very irregular form. She stated, that it had at first shewn itself at the lower part of the abdomen, on the left side; but now the most prominent part was on the right side, not far from the head of the colon, where a hard, round projection was both seen and felt. Several other round, hard masses might be plainly ascertained by the touch; one nearly in the situation of the liver;

and another to the left of the umbilicus, and one below.
There was, besides, a distinct, general fluctuation; and
in several parts, on making the parietes move gently, a
peculiar feel, like a slight crepitus, or like the crackling feel
of new leather, was to be distinguished.

I considered this to be either an ovarian tumor, or a collec-
tion of hydatids; and that the peculiar sensation communi-
cated to the hand arose from adhesions between the tumor
and the parietes of the abdomen. I thought it by far more
probable that the tumor was ovarian, from the history, from
the fluctuation, and from the hardness of some portions of the
tumor. As the tumor was large, and from its size exceed-
ingly inconvenient, I spoke about tapping, in her hearing, but
found she most resolutely refused to consent to an operation.
My treatment, therefore, was confined to the application of
leeches, to relieve local pain (from which she suffered much),
and the regulation of the bowels, together with a few other
internal remedies, which suggested themselves as likely to
retard the increase of the morbid growth and effusion.

On the 7th of July she left the hospital, decidedly increased
in size, but still retaining a tolerably healthy appearance in
other respects.

When she had returned home, she continued to increase
in bulk—her legs swelled, becoming œdematous, and then
inflamed. She gradually sank, and died on the 31st of De-
cember 1830.

SECTIO CADAVERIS. — The upper part of the body greatly
emaciated: the legs œdematous, with desquamation of both
shins. The abdomen was of the most inordinate size, and
very irregular in its form: numerous veins ran over the
tumor, and were seen forming large plexuses on the chest.

The parietes of the abdomen were found to adhere very
generally, but chiefly about the central part, from side to
side, to the tumor within; and there was only about a quart
of limpid, straw-coloured serum in the cavity of the abdomen.
When the integuments and the attenuated muscles had been
pretty well detached from the contents of the abdomen, a
tumor, exactly resembling the external form of the abdomen,
was fully brought to view—the only difference being, that
the projections on its surface were rather more marked.
(Plate VIII.) It was now quite obvious to the feel, that the

whole was one large cyst, with several hard, flattened bodies, almost like the placenta, formed in its parietes. The intestines were forced back, out of view, to the left side, and the liver was quite pushed under the ribs, so that nothing was to be seen but the large ovarian tumor. An opening being made into the cyst, nearly six gallons of a tenacious, dingy-coloured fluid, of the consistence of thick gruel or very thick linseed-tea, were drawn off; and the cyst being laid open, a tolerably healthy surface was exposed, with a few uneven parts, where smaller cysts seemed to be pushing forwards into the cavity. The greater part of the thick, cake-like masses, which occupied at least two-thirds of the whole parietes of the tumor, were developed in the substance of the parietes, and projected outwards rather than inwards. Cutting into these masses, they afforded an appearance of cells filled with thick mucus, not unlike, in some parts, an enormous honeycomb filled with its contents (resembling Plate V.); and in one part near the iliac region, a large rounded mass projected, as an external appendage to the great tumor. On examination, it appeared that this was a cluster of cysts, more or less globular, which projected into a kind of chamber connected with the large cyst; the opening being formed by two or three crescentic margins, some parts of which were serrated with very fine spicula of bone. This mass of disease was attached entirely to the left broad ligament of the uterus: the ovary itself, however, could not be traced. The uterus and the right ovary were perfectly healthy; but the uterus was drawn round by the weight of the tumor, which, though it arose in the left side, lay very much to the right of the abdomen.

The viscera of the abdomen were in general healthy, as was the peritoneum of the intestines; which in no part adhered to the tumor, though the parietes adhered so generally. The liver was healthy. The kidneys were flaccid, and pale.

The chest was diminished in size by the tumor, which rose almost to the third rib. The lungs were healthy in structure, but gorged with blood.

In this case, it was not possible, from the want of observation by the patient, to say at what exact period the tumor first appeared; but it had not attracted her notice till August

1829, when the irregularity of the catamenia roused attention. The whole course however of the disease, from the time it was discovered till it proved fatal, did not exceed a year and a half.

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Dr. G. H. Barlow has kindly furnished me with the following case, illustrative of the fatal result of the ovarian tumor, when left entirely to pursue its course; and I shall give it in his own words.

CASE 11.
Compound Ovarian Cyst—the fluid never removed—death from irritation and exhaustion.

MRS. N., aged 35, had been delivered of three still-born children; and had menstruated regularly till January 1837, at the end of which month the catamenia appeared for the last time. She soon after observed her abdomen gradually enlarging; and in the middle of June she made application to an accoucheur, to arrange for her confinement, which she said she expected would take place towards the end of October. At the time of her application, she was, I am informed, about the size of a woman in the fifth month of pregnancy, and she said that she felt the motion of the child. She appears to have had no misgivings till within a few weeks of the time of her expected confinement, when she said she felt as she had never done during any former pregnancy : her bowels were then exceedingly irregular, and she had occasional vomiting. The tumor, I am told, then felt rather lobulated. She continued to enlarge, and suffer increasing inconvenience, till January 1838, at the end of which month I saw her for the first time. She had a dingy sallowness of complexion, and was then unable to lie down, owing to the pressure of the distended abdomen; which was of a size far exceeding the greatest enlargement of pregnancy, and was marked by a number of veins of great size. The abdomen felt rather lobulated, and there was rather indistinct fluctuation at the upper part; but inferiorly there was none ; and at this part the abdomen felt as if it contained a large hard mass. There was no resonance upon percussion about the epigastrium; but there was some in the right iliac fossa. Her urine was very scanty. Paracentesis was suggested, but to this the friends

would not consent. I saw her a few days afterwards; when her
legs were much swollen, and had given way in several parts.
The abdomen then felt exceedingly tense; but the sickness
had been less distressing. She continued for about five days
to undergo no change, except that of increasing debility, and
a return of the vomiting; at the end of which time she
sank exhausted.

SECTIO CADAVERIS.—The abdomen only was examined. It
contained a large tumor, which was nearly free from ad-
hesions, so that it could be removed entire. It appeared to
have originated in the left ovary, which was adherent to, or
rather seemed to form part of it. The small intestines were
nearly all collected in the right iliac fossa; and portions of
them, as well of the jejunum as of the ileum, were of a deep
brownish red, both externally and internally, as if from ex-
cessive congestion. At these parts, grumous-looking blood
could be squeezed from the mucous membrane. The tumor,
when removed, was seen to be nearly spherical, and measured
just two feet in diameter. That part of it which was situated
superiorly, consisted of three or four large cysts, which con-
tained a thin glairy fluid. The inferior portion was of a much
more complicated structure: it consisted of cysts of every
size, from that of a large orange to that of a pin's head, the
larger cysts being lined by smaller ones. In the lowest part
of the tumor, all regularity of structure seemed merged in
that of a cellular substance, containing here and there a cavity
of the size of a large pea. The contents of these cysts varied
from the clear glairy fluid, mentioned as having been found in
the larger cysts, to an opaque substance of the colour of pus,
and having the consistency and tenacity of the muco-purulent
expectoration sometimes voided by bronchitic patients. The
kidneys were healthy.

In this case we have another instance of death from the
simple effects of the enormously enlarged ovarian tumor; and
scarcely more than a year had elapsed since the first disco-
very of the disease. The cyst afforded a very excellent exam-
ple of one form of the complicated tumor; but although this
and the last case ran their course so rapidly, when unaided by

art, there is reason to suppose that a great many cases would
be much slower in their progress to a fatal termination.

Case 12.
Ovarian Dropsy, fatal from Peritonitis after the partial abstraction of the fluid.

A. B. was admitted into the hospital on the 8th of April,
with a large fluctuating tumor of a globular form, occupying
the whole abdomen. After being in the house a few days, a
portion of the fluid was drawn off, and proved to be of a dark
coffee-ground appearance. She became very low, with a dry
and brown tongue. Pulse faltering: abdomen very tender:
and in this state she remained till the 10th, when she died.

SECTIO CADAVERIS.—Signs of inflammation displayed them-
selves very extensively on the peritoneum, which contained
two quarts of dark-coloured serum. One large cyst occupied
the greater part of the abdomen, the parietes of which were
about a quarter of an inch in thickness; and within might be
felt other cysts, rendering the parietes more hard and unyield-
ing. It was removed from the abdomen entire; and was
found to be behind the right Fallopian tube, which was ex-
tended across it to the length of at least a foot, and was not
amalgamated into its substance. The fimbriated extremity
was free, but the orifice appeared obliterated. The tumor
arose distinctly from the situation of the right ovary; and the
ligament was seen gradually dilating to cover the sac, afford-
ing a radiated vascular appearance. No remnant of the na-
tural ovary could be discovered; and in all probability its
whole structure formed the basis of the tumor.

The cyst was injected; and, when laid open, was found to
contain five or six quarts of brown opaque fluid. The wall of
the cyst was about a quarter of an inch in thickness, somewhat
laminated in its structure, and having vessels in its substance,
the cut ends of which were seen when a section was made, giving
an appearance not unlike a section of the uterus. There were
also some cysts formed in a mass between the layers of the
chief cyst, and nearer the external than the internal surface.
This mass was formed of forty or fifty flattened semi-transpa-
rent cysts; some of the size of an egg, but many of them not
larger than a marble. On the inside of the large cyst arose
two brown fungous masses, apparently breaking down; and

in one part a portion of the internal lining of the cyst was detached, forming a kind of blister, large enough to contain a pint of fluid. There was also a small cluster of three or four pellucid cysts, which seemed to have been contained within the cavity of another which had sloughed away. On the outside of the main cyst were one or two fungous masses, not discoloured or sloughy. When the parietes of certain parts were taken between the fingers, they were obviously much thicker than the rest of the cysts, and were elastic; and on being cut into, found to be separated, as splittings of the lamellæ of the cyst, filled with grumous fluid; and within this was a deposit like the fibrin of blood coagulated and brown, but not having any cyst-like arrangement. The left ovary was quite natural, and the Fallopian tube on that side perfect.

This case furnishes an example of the compound ovarian cyst, involving, distinctly, the whole right ovary: and while its general structure was quite analogous to that which has been already described, it presented some peculiarities, in the unusual vascularity of the chief cyst, and the circumstance of its dividing into lamellæ, between which grumous fluid had collected.

This case also affords another example of peritonitis, following shortly after the partial abstraction of the ovarian fluid.

CASE 13.
Cyst, probably a diseased Graafian vesicle, communicating by ulceration with the colon—death from irritation of the mucous membrane of the large intestine.

MARY ANN JONES, aged 29, of a sallow complexion, was admitted, under my care, Nov. 2, 1835, with an indistinct tumor in the lower parts of her abdomen, and suffering great and constant pain. It appeared that about twelve months before she first felt a tumor in the left iliac region, which had gone on increasing till about three months ago, when diarrhœa came on, and with it the tumor decreased; so that it was now very much diminished; and was rather a diffused hardness than a defined tumor, extending from the crest of the ilium to the pubes, two or three inches in width. The motions

were frequently very copious, and of an unhealthy muddy appearance, but not obviously containing pus. The tumor seemed to vary in size, in some degree, according to the extent of the fæculent discharges. She suffered much pain and griping: the tongue was glossy and dry. Anodynes, and the gentlest laxatives, as manna and castor-oil, injections of gruel and poppy fomentations, formed the chief remedies; and by taking them with the mildest diet, she continued fluctuating, and occasionally affording some apparent hope of recovery: but at length she sank under great mucous irritation, after being in the hospital nearly four months.

SECTIO CADAVERIS.—On opening the abdomen, the omentum, somewhat loaded with fat, came into view, covering the whole intestines and glued down to the pelvis, passing over a tumor which arose over the pubes, nearly in the centre, but rather to the right side. There were no signs of recent peritonitis. On examination, it appeared that this tumor had probably been developed in the right ovary; but it had passed behind the uterus to which it was attached, and it had likewise become slightly glued in the sigmoid flexure; but the chief adhesion was to the cæcum, or commencement of the colon; and here ulceration had taken place, and an opening was formed: and when the cyst was squeezed, bubbles of air escaped through an opening into the cæcum. The fluid it contained was of a dirty dull-red colour. The cyst was firm, and nearly half an inch in thickness: its internal lining presented a very curious appearance, which I ascribed entirely to the contraction which had taken place since the evacuation of the fluid: it had an appearance of corrugation or mammillation, being thrown into folds of irregular polygonal forms, with deep fissures between them. The colour of this membrane was a dark olive green. (Plate X. Fig. 6.) The ascending colon and the arch were full of dark-coloured fluid, resembling that found in the tumor; but as the whole surface of these viscera had evidently been recently irritated, so as to present many small points of blood, it was difficult to say whence the fluid had come. The descending colon was more healthy; and, at its sigmoid flexure, was slightly attached to the tumor.

The uterus was large and flaccid.

In this case, we have an example of the mode in which life is generally terminated, when a cyst communicates, by ulceration, with the intestines; the irritation of the mucous membrane usually, sooner or later, exhausting the powers of the patient. In this instance, I think it likely that the cyst was of a less malignant character than is most common, and probably had its origin in a disease of the Graafian vesicle: of this, however, there is no proof.

<center>Case 14.</center>

Ovarian Cyst, probably a diseased Graafian vesicle, fluid partially removed—inflammation of cyst and peritoneum.

Hudson, aged ——, died on the 20th of April 1837. She was not under my own care, and I only saw her once or twice during life. In this case, it was intended to try how far the ovarian cyst might be gradually contracted, by drawing off small quantities of the fluid by successive operations: however, considerable inflammation succeeded the first attempt, and she had suffered a great deal from pain and tenderness of the abdomen ever since: an abscess had formed in the parietes, extending downwards towards the pubes. For some days before death, constant sickness, and frequent wandering and delirium, had marked the progress of the disease.

sectio cadaveris.—On opening the abdomen, it was found that the parietes adhered closely over the whole lower part of the abdomen, to the omentum, which was spread out over the cyst. The adhesion was so strong, that it was necessary to tear it away in every part; and the omentum and the peritoneal lining of the abdominal parietes were deeply stained with that carbonaceous deposit, which is the result of an alteration taking place in blood effused during or subsequent to inflammation.

The cyst occupied so large a share of the abdomen, that its upper portion rose to the situation of the stomach, and the intestines and liver were pushed up under the concavity of the diaphragm and ribs; and as the adhesions by which it was connected with the parietes were torn through, the cyst gave way in two or three parts, and puriform fluid escaped.

The cyst, when opened, proved to consist of one large cavity, which was filled with puriform serum; the whole

internal surface being irregularly but thickly coated with layers of yellow coagulable matter; and a process of ulceration was going on in those parts of the cyst which had given way when the parietes were being detached.

The fluid in the cyst differed entirely from that which had been drawn off two months before, which was a coffee-coloured somewhat grumous fluid, sparingly coagulable by heat; and there is no doubt that the purulent character which it now bore was the result of the inflammatory action set up in the cyst. The dark carbonaceous colour exhibited by the omentum and peritoneum had in all probability taken place subsequently to the tapping, as the abdomen had previously appeared quite free from inflammation; and there is little doubt that it depended either on the escape of a small portion of the fluid from the cyst, or on some slight sanguineous oozing from the wounded vessels of the omentum.

The perfectly simple character of the cyst in this case inclined me to consider it as probably an example of one of the non-malignant forms of ovarian cysts; though I own it was a point admitting of great doubt.

CASE 15.

Ovarian Dropsy—paracentesis—death from peritoneal inflammation.

——, aged 44, was admitted into Guy's Hospital, June 1831, affected with a large ovarian dropsy. She dated the commencement of her complaints to the day of Queen Caroline's funeral, when she caught cold by exposure to wet, and was confined for four weeks with inflammation of the lower part of the abdomen; and although she then appeared perfectly well, yet in a very short time she perceived a swelling in the left side of the abdomen, towards the bottom; and from time to time was subject to indisposition, generally affecting the abdomen. Although the swelling continued, she was married about six months before her admission, and since that time the swelling had increased more rapidly; but it did not interfere much with her proceedings; she could walk from Peckham to London and back, and she was fond of dancing.

June 18, 1831. She was tapped in the middle line, about

an inch below the umbilicus : a few drams only of fluid came away; when a little cyst protruded, almost like an hydatid; but it was attached within, and was returned : a small quantity of blood escaped. Within an hour or two of the operation she began to experience collapse, and died within twenty-four hours.

SECTIO CADAVERIS.—From external examination, it was concluded that there was one large sac occupying the greater part of the abdomen, so generally, that it did not appear to belong to one side more than to the other : but on the slope of the tumor, to the right side, in the iliac region, was distinctly to be felt a part harder than the rest; and here a projection could be perceived by the eye. The fluctuation in the great tumor was decided, but far from remarkable. When the parietes were removed, one large sac came into view ; and a few drams of puriform fluid escaped from between this and the parietes. The omentum was thin, and stretched over the right side of the sac. It was exceedingly vascular; and attached to a second tumor, of the size of a large fist flattened, which had formed the projection in the right iliac region. This tumor was lobulated in appearance, and of a dark grey colour. Across the large tumor, and running in a diagonal direction from the lower part of the right iliac region upwards to the left, passing within half an inch of the umbilicus, was a fleshy band, rounded at its upper margin, and becoming thin below. In this was perceived the slight scar of the incision which had been made to evacuate the fluid. Just below this belt, which ran below the umbilicus, and was about an inch in width, were two or three transparent vesicular bodies, hanging on peduncles.

On further strict examination, it was found that the large cyst arose from the appendages of the uterus on the right side, and that the fleshy band which crossed it was composed, in its upper part, of a large vein; and in its lower, of the Fallopian tube, connected, and formed into a mass by the thickened ligaments of that side of the uterus. The smaller tumor was appended to the larger, and hanging upon it. On opening the larger sac, it was found to be very thin, and contained a large pailful of brown glairy mucous fluid. The inside of the tumor was, for the most part, pretty smooth and

even, but in one or two parts presented the projections of secondary cysts. At the lower part of the tumor was found some gelatinous matter, which appeared to have subsided from the fluid contained in the cyst. The tumor in the right iliac region was filled with a peculiar mass, of the consistence of natural fæces, and brown in colour, with large flakes of white matter, which resembled adipocere ; and when this was completely evacuated, some small portions of bone, and a little hair, were found attached to one side of the parietes. The uterus was healthy, except that the neck was elongated by being drawn out by the tumor.

The intestines all shewed distinct marks of recent inflammation on their peritoneal coat, which was vascular, particularly in two stripes where each came in contact with the neighbouring convolution.

This case is very interesting, as it shews the great caution which is necessary in the performance of paracentesis in · this disease, and, indeed, the impossibility, in some cases, of avoiding parts which may be displaced. The unnatural elongation of the Fallopian tubes, and of the appendages, is by no means uncommon amongst the displacements which occur in tumors of this kind. The tendency to inflammation of the peritoneum, where the parts are greatly distended, and the sudden prostration arising from it, is also very worthy of observation.

CASE 16.

Cyst in the broad ligament of the Uterus — ruptured — death sudden.

JANE READ, aged 42, a married woman, was admitted into Guy's Hospital, June 30, 1830. It appeared, from her account, that she had been in the hospital rather more than a year before, the subject of an abdominal tumor, with œdema of both her legs, which was supposed to arise from venous obstruction. From the central position of the tumor, pregnancy was at first suspected, but this idea was abandoned. She was at that time rather stout, and left the hospital free from anasarca, though the abdomen remained unchanged.

She was somewhat emaciated in appearance. The lower

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part of the abdomen tumid and hard, with scarcely any perceptible fluctuation. The lower extremities œdematous : the superficial veins of the abdomen much distended. She stated that she had passed no urine for some days ; except a little which came away in certain positions of the body. The catheter was passed with much difficulty, owing to the orifice of the urethra being drawn back. The urine was slightly turbid. Twenty leeches were applied over the abdomen, followed by fomentations and poultices, and soothing injections were administered.

On the 7th day after her admission, having been sitting up a few hours before, and speaking of no new symptom, except a sensation, at one time, as if her bowels turned over, she died quite suddenly.

SECTIO CADAVERIS.—The appearance of circumscribed swelling had entirely subsided. The abdomen, though swollen, was flaccid, like a half-filled bladder ; and the idea immediately presented itself that the rupture of the cyst had taken place ; which, on laying open the abdomen, was found to be the fact ; for a quantity of discoloured ropy fluid escaped, which was found to have proceeded from a large cyst which entirely occupied the lower part of the abdomen. The parietes of the cyst were extremely unequal, in some parts thick and fleshy, in others thin and tender ; and it was in one of these thin parts that the cyst had given way, allowing the escape of its contents. Considerable evidence presented itself of peritoneal inflammation, particularly about the spleen, where adhesions had taken place.

The cyst had evidently originated in the broad ligament, near the uterus ; and had insinuated itself even under the peritoneal covering of the uterus.

CASE 17.

Ovarian Tumor, partly fluid, partly fungoid — paracentesis rendered necessary, from the great pain experienced — death, after several operations, from peritoneal inflammation.

MARY MARYETTS, aged 53, was admitted into Guy's Hospital, under my care, Oct. 17, 1832, the subject of ovarian tumor, from which she suffered extreme pain. She had been the

mother of eleven children, of whom the youngest was twelve years old. It appeared that about twelve months since she had been apparently in perfect health; but about eleven months ago, she was supposed to be labouring under a liver complaint. Six months since, she passed what were considered several small biliary calculi; and about that time she first felt a swelling at the bottom of the abdomen, towards the right side. This gradually increased, from the size of a potatoe till it occupied a large portion of the abdomen, and was attended with most violent pain. Having suffered this pain for about a month, it became almost insupportable; and two months and two days ago she was tapped; when eight pints of dark thick fluid were drawn off, with the greatest immediate relief to the pain, and increased freedom of passing urine; and she left the hospital in ten days, at which time the accumulation was already taking place, and it had continued to increase till it was now arrived at its original size; and had latterly produced great pain, particularly at the time of passing fæces. Urine scanty, but general health good.

A dose of castor-oil was ordered: and on the 20th, three quarters of a pailful of greenish straw-coloured fluid, mucilaginous in appearance, with much yellow flaky matter, were drawn off; and when the cyst was emptied, two other tumors were plainly to be felt. The next day, the pain she had experienced was quite gone, but a little tenderness remained on the right side of the abdomen. I ordered the ointment of the hydriodate of potash to be rubbed in on the abdomen; but she was so well, that, although the fluid had begun to accumulate again, she left the hospital on the 6th of November.

Dec. 12. Was again admitted, under Dr. Back; the tumor having arrived at even a larger size than before. A purgative was administered, and in two days she was tapped. The fluid drawn off was described as being very thick, almost like jelly; and after the puncture had been bandaged up, it broke out again, and flowed in large quantities into the bed.

17. She appears very well: the hard masses, which are evidently cysts in the parietes of the large cysts, are very evident.

22. For a full week after the operation the fluid con-

tinued to drain off: it has now, however, quite stopped, and considerable accumulation has again taken place.

26. She was sitting up, eating her dinner with other patients; and she shortly afterwards left the hospital.

Jan. 30. She was again admitted, suffering great pain. with a tumor occupying the whole center of the abdomen, fluctuating, and very tender, particularly on its upper part.

Feb. 2. Suffered most acutely from pain in the back, and round the abdomen, during the night. Mr. Callaway made a puncture with a lancet, an inch and a half below the umbilicus, and introduced a canula. Four quarts of ropy greenish fluid, containing some white flakes, were drawn off. At one time the canula was obstructed by a portion of fine membrane; which was drawn out and cut off, having a small cyst attached. A bandage was applied, with moderate pressure. The abdomen diminished about four inches in circumference; and a hard transverse tumor could be felt on the left side, extending from below the umbilicus towards the loin. The most prominent hardness was on the right side. In the evening she was sick, and dyspnœa came on.

4. Abdomen very tender; and the cyst has filled so much, that she measures within one inch and a half of her size previous to the tapping. The tumor in the lower part is hard, and very distinct fluctuation is felt in the upper.

7. All tenderness is gone.

13. Some shooting pain in the right side, extending into the iliac fossa; and that part is very tender to the touch.

March 2. Nearly as large in measurement as at the time of admission.

14. Has suffered much pain in the loins, and round the upper part of the abdomen; and cannot cough, or take a deep breath, without pain. Paracentesis was performed, as before: at first, some serum escaped, which was supposed to be from the peritoneal cavity; and then some ropy matter, which, towards the termination, was of less consistency, and changed from a dirty white to a light greenish hue. Several portions of opaque membrane of some strength, and one of them in the form of a cyst, escaped at the orifice, and required to be detached by scissars. The quantity drawn was about

two quarts: she felt afterwards rather exhausted, but the breathing was better than before the operation.

16. Passed a tolerable night, and appears quite cheerful. Sickness has subsided: pulse 100, soft: some healthy dejections passed, with less pain than before tapping.

18. Was very comfortable yesterday; but on getting out of bed this morning, and coughing, the puncture re-opened, and some fluid has been oozing. Passed a pint and a quarter of urine. The fluid being inclined to flow, about three pints of a yellow turbid fluid, slightly unctuous to the feel, was drawn off.

19. More fluid, to the amount of one or two pints, escaped from the orifice: feels weaker: pulse feeble: tongue clean: not much abdominal tenderness: no stool: more urine.

20. Vomited last night, and continued to retch all night: has vomited this morning; and at present there is coldness at the extremities. Pulse 104, very small.

21. Has been getting much worse since half-past two this morning, not having spoken. At present she is almost in a comatose state, giving no answer to questions put to her. Vomited last night: bowels not open: extremities warm; but her pulse flutters, and is scarcely perceptible: occasional subsultus and picking of the bed-clothes.

SECTIO CADAVERIS, *March* 23.—Much emaciation—the superficial veins, both on the hands and legs, very strongly marked. Opening the parietes of the abdomen, they were found very closely attached, particularly at the upper part, to an ovarian tumor. This tumor was composed of two parts, very different in their appearance: and seemed to fill every portion of the abdomen, when it was first opened. The upper part passed quite under the ribs, on both sides, and in the middle; and was exceedingly thin, so that the fluctuation could be seen plainly through the integument of the abdomen. The lower part of the tumor, which was of the size of a half-quartern loaf, was apparently solid; and, externally, somewhat botryoidal, and very vascular. The thin part of the tumor was also somewhat vascular; and had upon it some very peculiar white marks, terminating abruptly in the vascular parts.

The thin tumor contained several pints of very tenacious

matter, which flowed out precisely like the white of egg, falling to the ground, from the table, without the least noise, or making any splash; exactly as the white of an egg falls into a basin: it was of a dingy brownish colour. The inside of the cyst had but little appearance of vascularity; was in some parts quite smooth, like membrane; and in other parts botryoidal, from other cysts pushing forward; some, small as peas; others, particularly in the neighbourhood of the hard tumors, a good deal larger, and opening spontaneously, to let out some more fluid still more tenacious, like glue or bird-lime, which separated from the cavities in which it was contained, leaving them quite dry; but shewing fresh botryoidal masses shooting up.

The hard tumor, when cut completely through, shewed a section which exactly resembled a somewhat magnified fungoid testicle; in which every shade of colour, and every variety assumed by the fungoid disease, occupied the various cysts of which it was composed: some were still like white of egg, but others were bloody; and some of the colour of the cheesy matter of scrofula.

The whole of the tumor arose from the right broad ligament; and it appeared to be the ovary itself. The Fallopian tube, still quite pervious, and about six inches in length, lay extended over the tumor. The left ovary was shrunk and small; but at its lower part there was a vesicle of the size of a bean, which seemed to be formed within the tunic of the ovary, and was filled with a pellucid fluid, bearing very much the character of that represented in Plate II., and, in all probability, the incipient stage of the same disease as that which occupied the other ovary.

The uterus was healthy, with some white mottling, probably the result of frequent child-bearing. The peritoneum was extensively inflamed; and, besides containing some of the ropy fluid which had escaped from the cyst, had poured out a good deal of puriform lymph.

Almost the whole of the natural contents of the abdomen were pushed into the two lumbar regions: and the tumor appeared to have made such pressure on the lacteals carrying the chyle from the small intestines, that they were enormously distended, and a most extensive extravasation of

chyle had taken place into the mesentery, about midway along the small intestines; and, at the same time, many small collections of chyle were seen immediately beneath the mucous membrane of the intestines, between that and the muscular fibres.

The liver was rather soft and yellowish; and was pushed upwards by the tumor, so as to be lodged under the third and fourth rib. Spleen, pancreas, and kidney, healthy.

In this case, we see very plainly marked the transition from the less malignant form of the ovarian cyst to the most complicated varieties of fungoid disease: for though the large cyst was filled with the usual mucilaginous matter found in the cells of ovarian disease, yet the harder part, which formed no small portion of the whole, presented all the various modifications of the cerebriform and hæmatoid fungus.

The progress of this disease had been rapid; for not above eleven months had elapsed since it first made its appearance. In about four months from its being first discovered, it was necessary to draw off the fluid; which was again so far accumulated, as to be most inconvenient and painful within two months afterwards. After that time, it was again necessary to have recourse to the operation; then in six weeks; and again, in a still shorter time. Nor did she long survive this fifth operation; but a small quantity of the fluid having been effused into the peritoneal sac, inflammation came on, and she died. But while inflammation appeared to be the immediate cause of death, the rapid emaciation plainly shewed that there were other causes in operation: and the remarkable instance this case affords of the effect of pressure, in cutting off the supply of nutrition, and actually preventing the lacteals from absorbing the chyle, sufficiently explains the source of emaciation.

The urgency of the symptoms, the pain, and the white flaky matter which was mingled with the fluid drawn away, may all be considered to have indicated the peculiar character of the disease.

CASE 18.

*Ovarian Dropsy—possibly enlarged Graafian vesicle—rupture
of the cyst internally—death from inflammation of the cyst
and neighbouring parts—the cyst tympanitic.*

JANE ROUSE, a married woman, aged 37, was admitted, under
my care, into Dorcas Ward, Sept. 2, 1835. She had a light
complexion, and was by no means emaciated. When she
presented herself in the room for admission, she stated that
she had observed a swelling of the abdomen for two years,
but that for the last six weeks only had she suffered from it;
since which time the pain had been great and constant. As
she sat, the abdomen was evidently much enlarged at the
lower part, and yielded an indistinct sense of fluctuation.
I considered it ovarian, from her history. On questioning
her more particularly, when removed to the ward, I found
that she had been married for many years: the catamenia
had always been regular, but she had borne no children.
About two years before, she had first perceived, or at least had
her attention particularly drawn to a swelling in the lower part
of the abdomen: it was accompanied by a stoppage in the
urine, which rendered it necessary to have a catheter passed.
She seems at that time to have been ill for a considerable
period; but, ultimately, the swelling subsided completely.
It however again made its appearance; and a second time
subsided; so that, for a time, as she stated, the abdomen was
as flat as ever it was. Six weeks before admission she again
perceived the enlargement; and from that time she had suf-
fered great and constant pain. On careful examination, I
could discover no distinct tumor; no marginated enlargement;
no lobulated or hardened knots: there was indistinct fluctua-
tion; and the abdomen was tender on pressure, without acute
pain. Pulse 120, sharp; tongue slightly furred, and dry; and
she altogether appeared greatly prostrated.

The conclusion to which this examination led me, was, that
there could, at all events, be no hard or malignant disease of
the ovary; that there was probably chronic inflammation of
the peritoneum, excited by the previous disease; and that the
membrane had become thickened and altered, so as to prevent
that distinct fluctuation, which otherwise, from the considerable
size the abdomen had obtained, might have been expected.

I thought it right to have the catheter passed ; but no material quantity of urine was found in the bladder. Twenty leeches were applied to the abdomen, followed by a poultice ; and a pill, composed of a grain of opium and calomel, and one-fourth of a grain of tartarized antimony, was given three times a day. The following day the tenderness was somewhat diminished, and the bowels had been twice relieved—the motions loose, but well supplied with bile : a small quantity of blood was taken from the arm, and again leeches applied to the abdomen ; but the irritation of the bowels increased, and it was necessary to have recourse to starch injections with opium, and gently to give support : however, the tenderness of the abdomen increased ; it became tympanitic; a large tympanitic ridge, corresponding to the arch of the colon, passed over the abdomen, above the umbilicus; while the lower part was also tympanitic ; but fluctuation could still be discovered in its lower part, as she lay on her back. On the 11th of the month, that is, ten days after admission, she sank.

SECTIO CADAVERIS.—No obvious change had taken place in the appearance of the abdomen since death : it still presented two remarkable elevations—the one crossing the epigastric region, the other occupying the hypogastric and umbilical; and both were decidedly tympanitic on percussion ; but fluctuation was still ascertained, in the inferior and posterior part of the lower tumor. When the parietes were divided, a spherical tumor came into sight, completely occupying the lower part of the abdomen ; while, nearer to the diaphragm, the colon, greatly distended, filled all the remainder of the cavity which was brought into view. They were both evidently distended with gas, yielding a tympanitic sound, on percussion : and it was at once obvious, that the lower tumor was attached to the uterine appendages, as the left Fallopian tube was seen drawn over its exterior surface. When pierced by a scalpel at its upper part, nothing escaped but a large quantity of fetid gas : and attempting to turn aside the arch of the colon from the tumor, it was found to adhere firmly; and many pints of a fetid grumous fluid flowed from the sac, through the rent made in its walls by this attempt to detach it. Examining more carefully, it was found that a similar attachment had taken place to the head of the colon ; and

that the sac was, moreover, closely glued to the small intestines; and that a collection of ill-conditioned pus had formed in the folds of the mesentery, at that part. On laying open the tumor, it was found to consist of one sac, about the sixth of an inch in thickness, apparently quite simple in its structure. Its internal surface was somewhat flocculent throughout; but in the parts where the adhesion had taken place, both near the head of the colon and at the mesentery, the internal membrane of the sac was softened, ulcerated, and cerebriform, so as to allow of communication with the adventitious abscesses, which had been formed externally by layers of coagulable lymph and folds of the mesentery.

From the simple structure of the cyst, and from the condition of the right ovary, in which more than one of the vesicles of De Graaf were diseased (one forming a cyst representing, in miniature, the large one, and the other filled with yellow matter), there was reason to believe that this tumor might have arisen from one of these vesicles in the left ovary.

All the peritoneum shewed marks of recent inflammation going on in many parts, to the formation of tender bands of adhesion between the different portions of the mesentery and the intestines. The internal membrane of the last few feet of the ileum, and that part of the colon near the valve about which adhesion had taken place, presented most extensive evidence of old ulceration; but whether any actual communication existed between the intestine and the large cyst, was not completely made out, though the appearance greatly favoured the idea. The mucous membrane of the stomach was unusually mammillated, but colourless. The kidneys and bladder were healthy: indeed, except some concretion in the gall-bladder, and some old adhesions of the pleura, all other parts appeared healthy.

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Reviewing the history of this case, and comparing it with the appearances after death, the conclusion to which I come, is, that this was probably a non-malignant disease of a Graafian vesicle; that the cyst had twice burst, and emptied itself into the cavity of the abdomen; but, that though no fatal result had immediately followed, the consequence was such a change, from the inflammatory action excited, as to lead ultimately

to the extensive formation of abscesses in the lymph deposited between the folds of the peritoneum; and hence arose the lesion of the intestines and the inflammation of the sac which formed the chief part of the disease under which she sank. From the situation which the cyst occupied with relation to the Fallopian tube, it is evident that it had been developed in the appendages of the uterus; and it was equally evident, that neither its structure, nor the fluid which it contained, nor the effects of the inflammation excited, bore any resemblance to those which mark the malignant or specific forms of ovarian disease. The inflammation which had left its traces in the peritoneum was evidently of old standing; and, supposing the adhesion of the cyst to have taken place on the first occasion of the disappearance of the tumor, we perceive a sufficient reason why the more satisfactory result, which probably sometimes follows such occurrences, did not take place in this case.

The circumstance of gas having collected in the cavity of the tumor, and thus affording a tympanitic sound, was one which seldom occurs; but where it does, it will be very apt to mislead us in our diagnosis, as the absence of the tympanitic sound on the upper part of the tumor generally distinguishes the ovarian from the ascitic tumor. Perhaps, could we trace with certainty the result of those cases which are reported as recoveries from ovarian dropsy by rupture, many would be found to correspond very exactly with that of Rouse; or to give evidence of a still nearer approach to the malignant form of disease, being scarcely more retarded in its progress by the internal rupture than it would have been by the operation of paracentesis. Thus, for example, in the case recorded in the First Number of these Reports, although the relief experienced, after the rupture, was so great, yet scarcely had two years elapsed before the patient returned to the hospital with the abdomen enlarged nearly as much as before the occurrence; and in a short time her death afforded an opportunity of examining the condition of the abdomen, and discovering that the ovarian disease had been of the specific character, and that an extensive rupture, of several inches in length, had suffered the fluid to escape. I will subjoin the examination, in the words stated in the book of our Museum.

<center>CASE 19.</center>

Malignant Ovarian Cyst ruptured internally — subsidence of the tumor—death in about two years, from increase of the disease.

ANN BINKS, aged 47, was re-admitted into Guy's Hospital, July 19, 1836, under Dr. Addison, and died on the 19th of the following month. Her case will be found in page 41, Vol. I. of these Reports; where it appears that she was admitted in March 1834, on account of the rupture of an ovarian tumor which had been observed for a period of five years. After having been in the hospital about six weeks, she left it, returned to her duties as a servant, and is reported in the December of the following year to have experienced no return of the dropsical effusion, though a small tumor was still perceptible.

" SECTIO CADAVERIS.—The body was much emaciated. The chest presented little that was unhealthy, besides one or two sub-pleural tubercles of a vascular and firm medullary matter, thin and flat, and rather less than a sixpence. The middle of the anterior face of the right ventricle presented a patch of simply thickened pericardium, as large as a shilling. There was a little serous effusion in the peritoneum, with much thickening and adhesion, especially about a cyst which was at once brought to view : the remaining serous surfaces were somewhat scabrous. The liver was nearly twice as large as usual, from the development throughout its substance of malignant tubera, differing in size from that of a pea to that of a walnut. These were globular, medullary, vascular, soft, and reticular, and containing coarse grains of strumous deposit, partly inclined to soften down. Few of these tubera were flattened at the surface of the liver; or they were less so than usual, being rather prominent. The hepatic substance was much injected, coarse, and firm : some parts had the character, slightly, of fibrous medullary degeneration. The surface of the liver was pretty generally concealed by adhesions, and its edges rounded by the development of great tubera. The bile was dark, watery, and in moderate quantity. The spleen was of a full size, much enveloped in adhesions; and one-fifth of its tunic was thickened, cartilaginous, and yellowish : its substance lacerable, softening, yet fibrous. The

kidneys were large, vascular, somewhat mottled and firm, not easily parting with their tunics. The ureters were thick. The omentum a good deal contracted, and sprinkled with firm palish medullary tubera. The pancreas was firm and close, and much enveloped in morbid thickening and malignant deposit.

" The cyst occupied the true and false pelvis: it was globular, and separated with difficulty. Its serous surface was thickened and irregular ; in parts smooth ; and in parts adherent by bridles, and a dense cellular membrane, to adjoining surfaces. Between this and the pubes the bladder was compressed, but pretty natural in appearance. The walls of the cyst varied in thickness about one-third of an inch: some firm pale medullary tubera were found about it; and the absorbent glands were much affected with a similar degeneration. The contents of the cavity were nearly two quarts, of a puriform and rather pasty fluid, darkish, as if discoloured by admixture of a little decomposed blood : the smell was not remarkably offensive. The lining of the cavity consisted mostly of a rough, thickish, and pretty firm layer of unorganized and, as it were, strumous matter. A puriform cell was found at one point on the walls. Across the front of the tumor, the wall of the cyst presented a band formed by its reduplication — a thickened portion of three layers, firmly and closely glued together, and each a little wasted, evidently produced by the former shrinking of the cavity. Posteriorly, it was quite evident that a rupture had occurred, perhaps eight inches in length. The inferior lip of the rupture projected into the cavity, in the form of an elliptical layer, of about six inches square ; of which one margin was free, like a recently clean-cut surface; and the other simply continuous with the proper walls : whilst what had originally formed the outer surface, though bathed in the contents of the cavity, was still a clear dense peritoneum, and the face correspondent to the lining of the cyst resembled it (the lining) in all respects.

" The rectum wound over the hinder face of the sac; and beneath the promontory of the sacrum was loosely enveloped in tubercular disease. The uterus was nearly twice as large as is natural, in consequence, as it seemed, of a kind of fibro-

scirrhous degeneration, uniform throughout its texture. The right ovary was pretty natural, but enclosed in adhesions; the Fallopian tube dilated, tortuous, and sealed towards the morsus; the left broad ligament not traceable. The os uteri tumid; and its inner lip afforded a short foot-stalk, a third of an inch thick, to a tumor the size of a chesnut, soft, vascular, and full of large mucous cells."

There is, I think, in this case, reason to suppose that the extensive rupture of the ovarian cyst, by diffusing the malignant matter in the peritoneal cavity, facilitated greatly its absorption into the system; as shewn by the occurrence of the disease, not only in the parts to which it was immediately applied, but in parts, as the substance of the liver and the pleura, where no such contact could have taken place: for we certainly find, in a great majority of cases where this malignant disease occurs in the ovary, that it confines itself very much to that organ, being almost insulated by the cyst in which it is contained; and that when it becomes more general, it is often after inflammation has been excited by paracentesis.

The case which I shall now shortly relate, from the report of my friend Mr. Beaumont of Gravesend, was followed likewise by a fatal termination, within three years of the accident; and, except that the sac appears never to have filled again, bears much resemblance to the case I have just mentioned, and was in all probability brought to an end by the development of the disease in some internal organ.

Case 20.

Ovarian Cyst ruptured internally—death after three years, with emaciation.

" MY DEAR SIR,

" The case you refer to was that of a woman who was a Se-
" cond Housekeeper at Cobham Hall: she had laboured under
" ovarian dropsy many years, but had never been tapped:
" she was very large, and I had thought of performing the
" operation. However, she fell from some high steps, in
" brushing the ceiling of a very lofty room, and burst the sac.
" The immediate effect was, fainting, from which she soon

" recovered by the administration of some stimulants. About
" two days after, I was desired to visit her, and found her
" without pain, but feeble; and my attention was directed to
" the quantity of urine she had passed: at the same time, her
" attendant produced three large chamber-pots full of urine,
" which had passed in twenty-four hours, and which increased
" quantity continued for four or five days afterwards. I
" ordered her to be supported; and a bandage to be applied to
" the abdomen, the pressure being increased as it became
" slack. In a week or ten days she resumed her duty. About
" six or seven months after this, I lost sight of her; but
" to-day have learnt that she became a monthly nurse; and that
" she never filled again, but, on the contrary, became very
" thin and emaciated, and died in London about two years
" afterwards.
   " *Gravesend, Jan.* 19, 1838."

CASE 21.

*Compound Ovarian Cyst, ruptured internally ; followed by
death from peritonitis.*

S—— G——, aged 44, who had been affected with ovarian
tumor for five years, was already dead when brought to Guy's
Hospital on the 22d of December 1832; and we were in-
formed that it was believed the cyst had burst internally.

SECTIO CADAVERIS, *Dec.* 22, 1832.—Great emaciation; slight
yellowness on some parts of the skin, more particularly on a
blistered surface at the scrobiculus cordis. The veins of the legs,
particularly the right leg and thigh, dilated and turgid. On ex-
amining carefully, a massive irregular tumor was felt, occu-
pying the central part of the abdomen, capable of being pushed
upwards above the umbilicus, but by no means to the scro-
biculus cordis: it might be pushed downwards to the pubes.
Fluctuation was to be felt all over the abdomen, even to the
scrobiculus cordis, and in the lumbar regions; but the abdo-
men was far from being tense: it was flaccid; and in the
lumbar spaces, particularly the right, there was no difficulty
in perceiving that there was a cyst, externally to which fluid
was effused.

   When the parietes were opened, a quantity of brown-red
fluid, of a thin serous consistence, immediately flowed out from

the general peritoneal cavity; and, as the opening was enlarged, the surface of an irregular lobulated cyst came into view, on which was deposited a thin coating of coagulable lymph, the product of inflammation, stained brown by a grumous deposit. (Plate IX.) The same deposit was found upon the convolutions of the intestines which came into view above the cyst; but in the upper part, and more particularly over the surface of the liver and the diaphragm, this soft brown deposit, which was evidently a combination of the lymph effused by inflammation and some foreign matter deposited, was much more abundant; and the liver was bound to the diaphragm by several adhesive fibres of half an inch in length, but pretty easily torn away.

The convolutions of the intestines were glued together, but separated with moderate ease. A part of the small intestines, the arch of the colon, the stomach, and the omentum, lay all very confusedly glued together between the tumor and the liver. The substance of the small intestines was somewhat peculiar in appearance, being more massive and opaque than natural, and seemed to have been thickened by the irritation and pressure of the tumor on the large intestines: they were not, however, distended; and the mucous membrane was healthy. The sigmoid flexure of the colon was exceedingly contracted, with a few small pieces of fæces in it, not larger than peas; and the caput cæcum was compressed, and pushed completely into the space above the right ilium.

The kidneys were very small, and of a pale yellow colour. The liver was remarkably friable; so that in squeezing it between the finger and thumb, the finger immediately broke through the peritoneal covering, and lacerated the substance.

The lobulated tumor at once shewed itself to be a compound ovarian growth; a larger cyst of which had burst towards the upper part of the mass, where an orifice, not larger than a small quill, allowed a fluid, precisely of the same character as that effused into the general cavity, to escape; shewing at once the nature of the circumstances which had been going on previous to death. On opening this cyst more freely, a considerable quantity of brown grumous matter, almost like the soft curd strained from treacle posset, was found deposited about the internal parietes. In the substance

of the parietes, and shooting up in it, were many of the subordinate cysts clustering together, one within the other. They contained fluids and substances more various in character than we often find. In none, however, was there the ropy gelatinous matter, which is most frequent : in some, a yellow transparent fluid—in some that fluid tinged with blood—in some small ones, almost entire blood ;—and in one large mass, all the cells were filled with a fungoid matter, almost cerebriform, with some cavities containing blood, giving the whole greatly the aspect of the fungus hæmatodes.

The whole mass was attached to a single broad ligament, which was somewhat twisted on itself. There was no other attachment, but a very recent bridle of adhesion towards the right side of the tumor.

The uterus was more bulky, round, and white coloured, than natural. The other ovary was not implicated.

CASE 22.

Malignant Disease of the Ovary—fibrous tubera in the uterus — paracentesis — subcutaneous tubera on the abdomen — death from extensive scirrhous disease.

June 7, 1829.—I was requested to see, in consultation, an unmarried lady, considerably past the meridian of life, who had been under treatment fourteen months for ovarian dropsy. For several months before that time, it had been observed that she grew large; but it was not looked upon as disease, till fourteen or fifteen months ago : for the last three months, the tumor had been rapidly increasing. It was in consequence of the absence from town for several weeks of the physician who had previously been consulted, that I was called ; and the points to be decided were, whether it would be right to draw off the fluid; and, likewise, whether it would be advisable to extirpate the whole tumor: for she had heard so much of the success of the last mode of cure, that she was quite prepared to submit to it, if recommended, and indeed unwilling to submit to any less decisive remedy. During the last week, the oppression and the general suffering had so much increased, as to lead to a feeling, that without some relief she could not long survive. I found the abdomen greatly swollen, and the ovarian tumor was

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plainly felt, extending within a few inches of the scrobiculus cordis, consisting of one large cyst, and of a mass of lobulated substance, which appeared to be a number of other cysts, situated towards the left side and on the inferior part, extending as high as the umbilicus.

It was likewise quite obvious, that a quantity of serum was effused into the cavity of the abdomen, lying partly between the cyst and the abdominal parietes, where it could be felt covering the upper part of the tumor over some space, and forming a thin layer of fluid on the side of the tumor: the fluid could also be discovered filling the lumbar spaces. She was much emaciated, and very feeble : the legs greatly swollen ; more particularly the left, which was inflamed, and going into a state of ulceration : the right was less advanced, in the same form of disease ; this inflammation of the legs having taken place within the last week. The tongue was aphthous, and naked. Pulse 124, weak. She suffered from very frequent hickup, particularly excited by swallowing any thing.

It was our opinion, in consultation, that to attempt extirpation would be certainly fatal ; and that possibly paracentesis would be so likewise, by the subsequent inflammation either of the cyst or of the peritoneum : but as it was likewise certain that she must die speedily by the inflammation of the legs, and the suffering of the distended abdomen, we judged it right to draw off the fluid by paracentesis.

A large trochar was introduced, three inches below the umbilicus ; and a pailful of dark-coloured fluid, like black tea or weak coffee, was taken away ; and towards the end of the operation, many shreds and masses of lymph and puriform matter blocked up the canula, but came away by the use of a probe : at length, all that could be obtained was drawn off ; and she bore the operation well. A large flannel bandage was applied, and an opiate given. She passed an easy day ; and a tranquil, though sleepless night.

June 8. The hickup better ; the legs much reduced: but as the pulse was quick and rather sharp, we feared inflammation, and ordered her to take two grains of calomel, with half a grain of opium, every sixth hour.

9th. A tranquil night : no pain : bowels well opened :

hickup much better: legs diminished: inflammation subsided: but the abdomen evidently again filling.

From this time I did not see this patient again, till after her death, which occurred on the 1st of July. I understood that no alarming symptoms of inflammation ever shewed themselves; but that the abdomen continued to fill, and that she grew gradually weaker.

SECTIO CADAVERIS. — Great emaciation: legs œdematous: abdomen greatly distended, as in the full period of pregnancy. The integuments for six inches round the umbilicus were thickly beset with small, hard, flat tubercles, about the size of a split horse-bean, or smaller: the skin was generally not discoloured upon these tumors, though a few of them appeared slightly vascular: these were precisely the sub-cutaneous tubercles observed in cases of scirrhous mamma, when the constitution is completely infected with the most malignant form of the disease: they were placed, like little glands, in the cellular tissue, immediately under the skin; were almost of cartilaginous hardness, when cut into; of a dead-white colour, and very slightly transparent. On inquiry, it appeared that these tumors had first made their appearance, like slight rings of ecchymosis, a few days after my last visit to the patient, and had since become hard and elevated. The discovery of these at once forced upon us the belief that the ovarian tumor would be found to be of a truly carcinomatous character.

About five quarts of clear serum, not unlike high-coloured urine, were drawn from the cavity of the abdomen; and about half that quantity, of a darker colour than we had obtained by tapping, flowed from the cyst. This was a good deal tinged with blood; and was accompanied by a large mass of brown coagulable matter, which, from its peculiar membranous and reticulated appearance, suggested the idea, as it pushed its way out of the orifice, of its being a portion of omentum.

When the parietes of the upper half of the abdomen were laid open, the colon came in sight, greatly distended with flatus; the omentum, rolled up and attached along the upper surface of the colon, of a dark grey colour, and studded

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with hard white tubercles, from the size of a small shot
to that of a pea rather flattened: the edge of the liver
was also seen; and about an inch in circumference of the
large curvature of the stomach. The fundus of the ovarian
tumor, now collapsed by the abstraction of the fluid, was also
seen suspended, by firm attachments, to the anterior part of
the abdomen about the umbilicus. On further examination,
it appeared that these attachments of the cyst to the parietes
were very firm, and formed by the deposit of an irregular
layer of the same scirrhous matter which formed the external
tubercles; and each attachment corresponded in its centre
with the space occupied by one of the tubercles: it extended,
however, considerably further on both sides: the sides and
the lower part, as well as the fundus of the cyst, were free
from attachments, and must have admitted the serum from
the cavity of the abdomen to lie between them and their
parietes, as was easily detected in the first examination.
Having torn the adhesions asunder, the lower portion of the
abdominal parietes was laid open; and we then found that
the cyst arose, by a broad basis not less than three or
four inches in circumference, from the broad ligament of
the uterus, which dilated, as it were, into the cyst. The
Fallopian tube, nearly as large as the little finger, and
elongated considerably beyond its natural length, lay firmly
attached to the back of the tumor: it was hard, and its
fimbriated extremity could scarcely be recognised: it was
thick, red, and warty in appearance, plainly partaking of the
general disease.

The external surface of the cyst exhibited, on its left side,
where we had felt the lobulated mass, the appearance of a
true scirrhous disease—vascular, lobulated, and of a cartila-
ginous hardness; and a large net-work of veins ran over part
of the surface: but the most striking appearance was seen
near the attachment, and towards its right side, from which
a pendent cluster of vesicles hung into the pelvis, mingled
with a gelatinous fluid, which filled the cavity of the pelvis
where it was not occupied by disease. This cluster of vesicles
corresponded with what Dr. Hodgkin has described as the
essential formation of many adventitious structures, and par-
ticularly scirrhus: it was quite obvious that it arose from

the bottom of a cyst which had burst or dilated, so that it now formed a crescentic margin, or rather a circular fold round the basis of the pendent vesicles, which all seemed to rise, by comparatively small bases, nearly from the same point: they were highly and beautifully vascular. The internal surface of the cyst was hard and scabrous throughout: it contained gelatinous matter, fibrin, and a clot of above two ounces of pure coagulated blood: some of the contents seemed to be glued to the parietes by soft, carcinomatous, and fatty-looking deposits; but I did not observe any subordinate cysts opening into the large cyst.

The uterus was also involved in the disease. From its fundus arose a large, oval, hard, and elastic tuber, of the size of a pigeon's egg; and in the substance of the uterus another was imbedded.

The right ovary was large; appearing somewhat, though slightly, affected with the same disease. The whole peritoneum of the pelvis was rendered rough by confluent, flat tubercles of the same carcinomatous deposit; and the same might be said of the peritoneum lining the parietes of the lower part of the abdomen. The other parts of the abdominal peritoneum were thinly studded with similar deposits, as were the lower surface of the diaphragm and the ligaments of the liver. I did not perceive any of these tubera upon the peritoneum covering the intestines; but some portions of the small intestines had a thin grey deposit upon them, which felt quite scabrous to the touch.

The bladder was greatly distended and vascular, and in one part slightly scabrous. The kidneys not obviously diseased. The liver was tolerably healthy, with no tubera in its substance: the gall-bladder empty. The stomach was pushed upwards and backwards; and was so small, that it would scarcely have held six ounces of fluid. The heart and pericardium perfectly healthy.

In the chest, great disease had been going on in the right side: it contained about four pints of serum: the upper part was clear yellow, but below was deposited grumous bloody fluid, and yellow gelatinous matter, not unlike what we found in the pelvis; and the whole pleura costalis was thickly covered by small scirrhous deposit, rendering it com-

pletely rough and hard: the lung was contracted to one sixth
of its natural size; but the upper lobe contained air, and was
rather emphysematous. On the surface of the liver, below the
pleura, were some small flat deposits of carcinomatous matter.
The left side of the chest contained a very small quantity of
fluid: the pleura costalis was scarcely affected with the
scirrhous disease: the surface of the lung, in two or three
places, had clusters of small yellow or white carcinomatous
deposits.

The foregoing case presents an illustrative example of one
of the more malignant forms of ovarian tumor, approaching to
the true schirrus; and shews, in a strong light, the morbid
tendency which often pervades the whole system, when this
destructive disease has once displayed itself. In this case, we
likewise see some of those modifications of the disease which
take place when it develops itself in different structures.
The uterus, the ovaries, and the various reflections of the
serous membranes, were the parts chiefly affected. In the
solid fleshy substance of the uterus, the disease had shewn
itself in the form of hard fibrous elastic tumors. In the
serous membranes it was seen as flat circular patches, of va-
rious sizes: in the integuments, it formed small rounded
bodies, like enlarged glands: in the loose texture of the ovary
it expanded into cysts: and probably, in each of these diffe-
rent parts, the disposition of the cellular tissue had the chief
influence in directing the course of the morbid matter, the
tendency of which is always, as it would appear, to deposit it-
self in that structure; and it seems that, wherever inflammation
is excited, when such a decided tendency prevails, the dis-
ease springs up. At what period of the complaint the perito-
neum and pleura had taken on this morbid action, cannot be
decided; but that a very short time is necessary for effecting
such changes as they exhibited, is plainly proved, by the
deposit of malignant tubercles in the cellular membrane of the
abdomen, within a few days after the irritation of passing the
trochar.

The length of time in which this disease ran its course is
not distinctly ascertained; but although the size of the body
had evidently increased for some months previously, it does

not appear that medical advice had been sought above fifteen months: and judging from the rapid progress made after this time, it is not unlikely that less than two years would include the commencement of the morbid growth; and it is even probable that the extension of the mischief beyond the ovary itself only dates from the time of the paracentesis being performed, when some of the fluid may have escaped into the peritoneum and cellular tissue.

It is but too well known, that a case of this kind admits scarcely of palliation, much less of cure; and it is well that this should be impressed on our minds, seeing how much misery and mischief may be added to the necessary grievances of disease by the rash interference of our art. Whether there had ever, in this case, been a serious thought of attempting the extirpation of the malady by the knife, I could scarcely take upon me to say; but certainly so much had passed, as rendered the patient herself anxious that something of the kind should be tried: and what the result of such a trial would have been, no one can doubt—useless agony to the patient, and deep mortification to the operator.

Case 23.

Ovaries affected with a modification of the malignant disease.—
The peritoneum extensively involved in similar affection.

Aug. 25, 1820. I was present at the examination of a patient who had died worn out under a malignant form of ovarian disease. We found both the ovaries equally involved; and together they almost occupied the whole cavity of the abdomen, pushing the viscera completely aside. The appearance of the ovaries, when cut into, was as if they were filled with a gelatinous matter, intersected by a multiplicity of vascular membranes, forming cysts. These held the mucilaginous matter, which resembled calfs'-foot jelly imperfectly cooled, so closely, that it was with great difficulty drawn out, but it appeared as if the general cyst or covering of the ovary, enormously distended, formed the general covering of all these minor cysts. In this case, most of the other viscera were tolerably healthy; but the malignant disease shewed itself very extensively on the peritoneum; for on first opening the abdomen, the omentum came into view as a flap of mucous

or fatty semi-transparent matter, granular in its texture, and slightly but universally adhering to the peritoneal lining of the muscles of the abdomen.   This same granular growth sprung up as an irregular covering to the whole lower surface of the diaphragm and the peritoneum, extending, along the sides of the abdomen, to the pelvis.   It covered the colon also, and formed a strong union between it and some portions of the small intestines.

Of the history of this case I have no record; but the disease of the peritoneum presented a modification somewhat different, yet nearly allied to that which occurred in the last case.

There is another modification which malignant disease occasionally assumes on the peritoneum, when the surface of that membrane, instead of being covered with flattened opaque tubera, or with semi-transparent granulations, is beset more or less closely with pendulous bodies, varying somewhat in the firmness or fluidity of the matter they contain.   As an example of this variety of malignant disease connected with ovarian dropsy, I shall here introduce another case, which I received from Mr. Beaumont, in the same letter as the case I have lately cited.

CASE 24.

Ovarian Tumor, with extensive growth of pendulous malignant tumors from the peritoneum.

" MRS. ——— had for many years laboured under ovarian dropsy.   I was requested to see her with the gentleman who had been in attendance upon her; and we drew off thirteen pints of a fluid resembling thick water-gruel.   She soon got about; but, within four months, filled again.   In the mean time I had seen my friend Dr. Blundell, and mentioned the case to him; when he requested that she might be sent to Guy's Hospital.   She went; and was examined by the Doctor, and by one of the surgeons.   The opinion was, that when she became so large as to require the operation, it should be repeated; and she should then be sent back to the hospital, that she might again be carefully examined.   This was done; and the letter she brought back stated that it was considered an unfavourable case for the operation of extirpation, on account of her

general health, and a suspicion of adhesion having taken place with some of the viscera. She died; and, upon examination, we found that there were adhesions, but none which were not easily broken down by the finger. The tumor, or sac, was of an immense size, and nearly of an hour-glass form, attached by a neck about the diameter of the thumb.

" The most curious part of this case was, that there were innumerable pendulous tumors, like polypi, transparent, and filled with a watery fluid, attached to the various reflections of the peritoneum, some of the size of a small pear. They were not hydatids."

I may remark on this case, that though I have occasionally seen the pendulous form of malignant tuber in different states, and amongst these a few containing a fluid, yet I do not remember to have met with any in which the affection has been so extensive as here described by Mr. Beaumont; nor in any case do I remember it as connected with ovarian dropsy. This, however, goes to shew how completely the ovarian disease identifies itself with all the varieties of malignant growth.

Case 25.

Malignant Ovarian Tumor, with Ascites, communicating disease by contiguity to the Sigmoid Flexure and Rectum.

Mrs.———— B————, aged —, had been in the Clinical Ward of Guy's Hospital during the winter of 1835; at first under the care of Dr. Cholmeley, and afterwards under mine.

At the time she came under my care, she was affected with a tumor lying obliquely in the lower part of the abdomen, very hard, and lobulated in its feel; which continued to increase very gradually; while at the same time an accumulation of fluid took place slowly in the general cavity of the peritoneum, which was most distinctly to be felt fluctuating, as a thin layer over the tumor: but the circumstance which was peculiar, and most distressing, was the condition of the bowels, which were greatly constipated, rendering injections constantly necessary; and the pain she suffered in passing her stools was so great as to require the frequent use of anodynes; and the dejections were composed chiefly of shreds of bloody mucus with a little

fæces. She emaciated rapidly; and finding no improvement, but, on the contrary, a gradual loss of power, she left the hospital.

I more than once referred to this case in the Clinical Lectures; all the symptoms leading to the supposition, that there was a malignant ovarian tumor which made pressure on the sigmoid flexure and the rectum, and had probably communicated disease of the same character to the intestines themselves.

After leaving the hospital, she came under the care of Mr. Kingston of Walworth : and the ascites having increased very much, and become very oppressive, he relieved her by drawing off serum to the amount of eleven quarts. But the operation afforded only temporary ease : the serum accumulated again rapidly ; and she died, exhausted, about a month after, on the 21st of May.

SECTIO CADAVERIS, *May* 22.—The abdomen greatly distended, and two or three small scirrhous subcutaneous tubercles were felt in the parietes. The intestines, distended with flatus, were distinctly seen, and recognised by percussion, floating on the serum. On opening the parietes, a great many quarts of yellow serum were found in the peritoneal cavity; and when this was drawn off, the edge of the liver, and part of the fundus of the gall-bladder, were seen at the upper part: beneath these the colon was much distended ; and below this, several portions of the small intestines occupied, together, above half the abdomen, while an ovarian tumor was situated in the lower half.

The tumor was formed in the left ovary, drawing the uterus out of its place; while the Fallopian tube and the broad ligament were stretched over it. It was composed of several cysts : the largest, about the size of a large melon, contained fluid. The different parts of the tumor were in different states. Some parts bore the appearance of fat, while some were decidedly cerebriform; and on the outside of the tumor were several lumps of a truly scirrhous hardness. It was attached closely by adhesions to the sigmoid flexure; and at the lower part glued to the rectum, which was converted into a scirrhous mass;—a state of things which I understood had latterly become cognisable by the touch.

The whole of the lumbar glands formed one scirrhous mass; the mesentery was studded with small hard round scirrhous tubercles; and a few were distributed on the peritoneal covering of the intestines.

The stomach, and its pylorus, healthy; the liver healthy, but a little pale; the gall-bldader distended with bile; the pancreas rather hard, and of a yellow colour, but without distinct scirrhous disease; the kidneys healthy: the uterus, although pressed upon and displaced, also apparently healthy.

This case presents a well-marked instance of a very malignant form of disease; shewing itself by its extension to the various parts with which it came in contact, particularly the glands of the loins, the peritoneum, and, above all, some portions of the large intestines. The cerebriform, the scirrhous, and the cystiform characters of the disease were all exemplified in this case; and the small subcutaneous tubercles presented an unerring proof of the peculiarly malignant nature of the affection.

CASE 26.

Ovarian Dropsy.—Cerebriform disease, communicating to contiguous organs.

IN the month of September 1837, I was requested to see, in consultation, a lady, the mother of a family, who, about eighteen months before, had suffered from prolapsus uteri, which had been relieved at the end of seven months; at the same time that a tumor had appeared in the right side of the abdomen; and it was conjectured that the rising of the tumor out of the pelvis had drawn the uterus up with it. In the course of about three months, fluctuation might be indistinctly felt upon the left side; and became gradually more and more distinct, occupying a larger portion of the lower part of the abdomen. At my first visit, I found that she had been labouring for the last three weeks under severe irritation of the stomach and bowels, sometimes vomiting bile; bowels irregular; appetite bad and capricious; much griping; peculiar spasmodic pain, brought on by motion or by coughing; tongue red at the tip and edges; lips parched; general emaciation

to a great degree: she was quite unable to leave the sofa. The tumor appeared to be one complicated ovarian mass, having a large collection of cysts in the parietes of its right side; with two or three smaller masses, besides one large cyst very thin and full of fluid, towards the left. It was to be feared, that this case having advanced so rapidly, and the constitution failing so much, a fatal termination would take place at no very distant period; although, at that time, there were no symptoms of a near approaching fatal event.

Oct. 10.   She has, upon the whole, been considerably better in her general health and spirits; the gentlest means having been used—Two or three doses of three grains of compound ipecacuanha-powder daily, and a small dose of castor-oil occasionally to regulate the bowels, with very careful attention to the diet.   Latterly, however, she has suffered a good deal from the tumor and its pressure; and on one occasion, about a month ago, she complained of much pain in the upper part of the left side for a day or two, which went off suddenly, with a feeling of something bursting or moving quickly from its place.   It was therefore determined to draw off the fluid by paracentesis: and a trochar having been used in the left side, six pints of fluid were drawn off.   It was as thick as pea-soup, and of a pink colour, looking very much like pus tinged with blood.   She bore the operation well, and the relief afforded was of the most marked kind.   The appetite, which had been almost gone, returned, even in excess.   No unpleasant symptom took place; and in about a week she got upon a sofa, and in a few days more was in the drawing-room.

Nov. 6.   I found her walking about the drawing-room: tongue less red: pulse below 100: countenance decidedly improved: abdomen a good deal enlarged.

Dec. 3.   She was greatly emaciated, and particularly for the last fortnight had been suffering a return of all her pains and all her worst symptoms; and, at a consultation, it was determined to have recourse again to paracentesis, as a means of affording temporary relief.   About six pints of thick pink-coloured fluid were taken away with some difficulty, owing to the frequent obstruction of the canula.

For two days after the operation there was a slight rally; but

then the pulse became quick; pains came on in the abdomen; the hectic symptoms returned; the appetite failed, and sickness ensued. She emaciated rapidly, and on the night of the 12th of December she died.

SECTIO CADAVERIS, *Dec.* 14.—The greatest emaciation : the abdomen was distended almost to the utmost : the integuments, from both these causes, were excessively thin ; and adhered very generally, but not firmly, to the outside of the sac. The sac was remarkably thin, and occupied the whole of that part of the abdomen which came in sight on first opening it. It was also attached very slightly to some of the small intestines in the left hypochondrium; and the omentum was stretched over the tumor, and closely attached to it. The tumor was still more closely attached to the right side of the arch of the colon; where, indeed, they were firmly glued together in a cerebriform mass, which had so far consumed the natural parietes of the cyst, that, on detaching it from the colon, no cyst was found, but only the diseased portion which adhered to the colon.

It was plain that the whole mass of the tumor was attached to the Fallopian tubes and the ligaments of the uterus on the right side ; and the Fallopian tube of that side was drawn out and stretched over the tumor; and carried in this so high, that the fimbriated extremity was attached to the margin of the right lobe of the liver.

All that part of the tumor which had felt so hard was one mass of cerebriform matter, assuming a somewhat lobulated form externally, and completely broken down internally. This cerebriform mass extended quite to the liver and colon; and the edge of the liver was infected with it, in the form of a tuber of the size of a filbert. The colon, though firmly attached to the mass, did not itself appear diseased.

There were at least two gallons of fluid removed from this cyst. That which first came away was fluid like sanguineous serum; but in the lower part of the cyst we had a thick, gruel-like matter, like that which had been drawn off. But the circumstance which first appeared peculiar was, that lumps of fatty matter, not unlike masses of dripping, were found floating in it: the origin of these, however, was soon

discovered; for in the upper part of the cyst, under the arch of the colon, was discovered a mass of hair and fat, evidently one of the masses which develop themselves in these structures.   There was still a very curious tumor discovered in the right iliac region, occupying nearly the natural situation of the cæcum.   It was about the size of the kidney, felt cellular, but with a kind of cracking feel under pressure : it was supplied with vessels which ran over the brim of the pelvis towards the iliac vessels, but otherwise did not seem connected with any organ : it was easily torn from its attachments ; and was then found to be a mass of hair and bony matter, containing two or three teeth with the alveolar processes, and apparently divided, in part, into cells.

On the convex surface of the liver was one fungoid mass, like fungus hæmatodes, of the size of a marble.   A firm coagulum was found in one of the veins on the left side of the pelvis.

Carefully examining the uterus, no portion of an ovary could be detected on the left side ; but on the posterior part of the broad ligament, very near to the uterus, was an obvious discoloured scar, with a few grains of bony deposit.   There was likewise a very peculiar appearance in the upper portion of the Fallopian tube, which presented a somewhat bulb-like form, and seemed as if it had been cut off by previous ulceration.   The kidneys were healthy.   The chest was not examined.

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In the foregoing case is an example of what is, perhaps, the most malignant form of the ovarian tumor—the true cerebriform disease.   Of the rapidity with which this modification of malignant action takes place, we have, occasionally, most striking examples in the internal organs, but more particularly in the liver ; and in the case before us, the whole period, from the first detection of a tumor in the right inguinal region to the day when death occurred, with all the extensive ravages we have seen, did not exceed fourteen months.   The cerebriform disease is, as far as I have observed, more apt to extend from viscus to viscus by contact, and less by what appears a diffused action through the system, than the true

scirrhus: and this might readily be expected, from the rapidity and disintegrating nature of its progress, which generally gives much less time than the true schirrus for the system to become extensively involved.

In this case, it appears probable that at some former period disease had taken place in the left ovary; which had actually been separated, and had fallen over to the right iliac region, where it had become attached : and that latterly the very same morbid tendency had developed itself in the right ovary; but here it had given rise to the most malignant form of disease.

In the cases which have now been brought together, we trace the history of the ovarian tumor through a great portion of the varieties it presents; and we find examples of most of the more striking circumstances which occur in the progress of the disease, and of many of the events on which its fatal termination depends.

In the first place, we have instances referred to, in which simple cysts have been found attached to the ovaries and uterine appendages, which have presented no character of malignancy, nor any apparent tendency to rapid increase. Cases are likewise stated by authors, where tumors bearing an equal and smooth surface have existed for a very considerable length of time, even for many years, without interfering much with the healthy functions. Well-authenticated cases are on record, where such tumors have apparently been ruptured internally by accidental blows, and the accumulation has never again taken place. There is reason to believe, in cases of this kind, and in some of those in which the tumor has been emptied by operation an almost indefinite number of times, without aggravation of the symptoms, that the disease has consisted of an accumulation of fluid in a simple cyst, without any tendency to a specific or a malignant action; but whether these collections of fluid are to be considered as belonging to simple serous cysts, to non-malignant disease of the Graafian vesicles, or to dropsies of the Fallopian tube, remains doubtful; and it is even possible that a certain proportion of these cases, as well as of reported cures by other remedies, may be set down as instances of erroneous diagnosis; for there is no question that the diagnosis is not always obvious; and there is one class of cases more particularly liable to lead the unwary and inexperienced into error respecting the disappearance of an abdominal tumor;—I mean, cases of hysterical distention of the bowels: for although the swelling in these cases is essentially tympanitic, yet occasionally, from the singular way in which the intestines are partially distended, and remain so for days and weeks at a time, they sometimes give completely the forms of tumors; and sometimes even indistinct fluctuation may arise from fluid fæces, or even from the co-existence of a distended bladder;

and sometimes the large accumulation of hardened fæces has led to a belief of a more solid tumor. And to shew that such a solution is not altogether hypothetical, I shall insert the following example.

CASE 26.

Hysterical distention of the bowels, mistaken for ovarian tumor —Operation to attempt its removal. •

SUSANNAH JOSE, aged 30, said to have been ill for two years, was admitted, under my care, into Charity Ward, September 29, 1824, complaining of abdominal pain and some hysteric symptoms. She had, in the middle line of the abdomen, about half way between the umbilicus and the symphysis pubis, an unhealed scar of about three inches in length. The deeper part of the wound had united; and it was filling up by granulation, as was a portion of the external part, at each end of the scar. It was evidently an incised wound : and the account she gave was, that her abdomen being swollen, as it was at the time she had formerly been in the hospital, a surgeon proposed to her the excision of a tumor which produced this swelling; and that, with two assistants, he prepared to perform the operation, and made a free incision into the abdominal cavity; but, finding that there was no tumor, brought the wound together; which now, after the lapse of several weeks, was as we saw it. The wound healed completely, under common treatment; but her health remained in a most unsatisfactory state, both from the frequent tendency to diarrhœa, and from the succession of pains, with occasional puffing up of the abdomen, of which she was the subject; so that she remained in the hospital till the 28th of December.

During this long confinement, the pains in the right and left sides of the abdomen frequently led her to request the application of leeches and cupping to these parts. Blisters were also applied : but the chief remedies employed, and which always proved most useful, were such as her hysteric symptoms were constantly suggesting. The tumor of the abdomen varied a good deal; and was, on one or two occasions, reported to have subsided entirely.

I may mention further, that I had seen this young woman

many years before, when she was in Guy's Hospital for a supposed abdominal tumor, under Dr. Marcet; who, however, soon discovered its hysteric character; though, certainly, the abdomen bore a very peculiar appearance, strongly resembling an encysted tumor: but there were connected with this supposed tumor so many other ailments, embracing fits of hysterics, epilepsy, paralysis, abdominal and lumbar pains, so varied and so changing, that a little observation was sufficient to convince any experienced person of its real character.

By far the larger number of the cases in the foregoing series are, however, to be referred to diseases of a very different character, connected with a much more disastrous history. A tumor is observed arising from one side of the pelvis; and is perhaps scarcely noticed, till it has already ascended half way to the umbilicus. Its progress is moderately rapid; so that, in the course of the first year or eighteen months, it has risen above the umbilicus, has spread to the other side, or has perhaps apparently filled the abdomen, the surface of which presents a network of distended veins, owing to the pressure on the internal vessels. Fluctuation, which at first was indistinct, has become very obvious and general; so that in vain do we seek, by percussion, for the sounds of hollow viscera, till we pursue the examination quite into the lumbar region of the opposite side; and within six months more, the pressure occasioned on every side renders it almost indispensable that the fluid should be drawn off. This fluid is glairy, or mucilaginous, or dark, or turbid, or loaded with cholesterine. When the fluid is nearly withdrawn, floating, as it were, in the flaccid abdomen, one or perhaps two or three hard bodies are discovered; one round; another flat, and shaped like a placenta. The fluid now accumulates still more rapidly. In a few months it must again be drawn off. Its character is often changed: it is more gelatinous or more opaque, sometimes becoming puriform; or it is mingled with blood or cerebriform matter. Operation succeeds to operation, with diminished intervals; the constitution sympathizes; and, after a limited number of months or years, the patient sinks, exhausted by weakness, overcome by inflammation, or worn out by pain. Nothing can, bespeak more plainly a disease differing widely

in character from the simple cyst, or from any accidental collection of serous fluid.

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From a consideration of the cases which have been now adduced, and others bearing on the point, we shall find that the DIAGNOSIS is not, for the most part, difficult, as regards the encysted character of the accumulation generally; but it is by no means easy, and is sometimes impossible, to distinguish between the simple and the compound cyst; because the secondary nodules are often very small, in comparison with some larger cyst; and are so situated, as to be quite undiscovered till the fluid has been drawn off; and occasionally so small, as not even to be felt when the cyst has been emptied.

The circumscribed extent of the tumor, and consequently of the fluctuation, distinguishes all ovarian cysts, in the early stages, from ascites. The fluctuation, uninterrupted by the intestines in any part, distinguishes the disease in more advanced cases. The lateral situation of the tumor, in the early stages, distinguishes it from pregnancy in the normal state of the viscera. Its duration distinguishes it in the more advanced stages: the suppression of the catamenial discharge adds probability to the existence of pregnancy; but there is no certainty to be derived from this indication; as in ovarian disease the catamenia are sometimes regular, sometimes irregular, some-times wanting: alterations in the mammæ are likewise uncertain indications; and in doubtful cases, nothing, except examination by the vagina, can give tolerable certainty; and then the shortened cervix, and the weighty feel of the uterus, would decide the question in favour of that organ. From the malignant disease of the fundus of the uterus, the situation will in part distinguish it: the hardness of the tumor, and the peculiar abrupt nodules which the diseased uterus presents, contrast well with the soft and yielding feel which the subsidiary tumors of the compound ovarian cyst usually afford. The origin of these cysts from the pelvis generally distinguishes them from all tumors of the abdomen, except diseases of the uterus, or a thickened or distended bladder; and the central situation of both these viscera suffices, for the most part, to fix disease upon them, when it exists.

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When paracentesis has been performed, the obvious character of the fluid which is drawn off will generally, in doubtful cases, prove a guide (pp. 187, 193, 200, &c.); and it appears probable that the chemical composition of the fluid (see page 210) may be further brought in aid of our diagnosis. Where the disease has assumed a very malignant character, we shall sometimes derive information of this fact from the hard subcutaneous knots which are developing themselves in the cellular membrane (pp. 194, 243, 246, 250): and when it is of importance, with a view to the performance of an operation, to be made aware of adhesions between the tumor and the parietes, the peculiar feel derived from pressing the hand on the parts, when the adhesion has taken place, will in some cases be instructive.   (Case 10.)

There are occasional complications, which it is not easy to meet by any general rules, but which attentive investigation will greatly tend to unfold; as, for instance, diseases of the other viscera—as the kidney, or the spleen, or the liver—pushing the impregnated uterus to one side, and thus disguising the real cause of the increasing bulk of the abdomen; or impregnation taking place during the existence of an ovarian tumor, and obscuring the nature of both; or the combination of ascites with ovarian dropsy, more particularly should that ascites have assumed a chronic form and be accompanied by thickened peritoneum; or even such chronic ascites uncombined may be easily confounded with the ovarian dropsy; or, lastly, such a condition of the cyst, that, owing to communication between it and the substance, gas is allowed to enter, or is generated in the cyst; in which case the tympanitic sound of the tumor would almost necessarily lead us into error as to its nature, were we not assisted by the history. (Case 18.)

Of such occasional complications I would willingly adduce instances, but that the length to which this communication has already been protracted renders it impossible to add more details. I may however observe, that in Plate X. Fig. 7, will be found a small sketch of an ovarian cyst, which, being complicated with a diseased condition of the peritoneum from its thickness preventing the intestines from floating, served to disguise a case of ascites, and to lead to the belief that the accumulation was ovarian, for a period of two or three

years, during which the patient was tapped twelve or thirteen times; and it was not till her death afforded an opportunity of examining the general texture of the peritoneum, that its true nature was discovered.—And I will likewise briefly mention, that a case occurred to me, of which I have the notes, where a woman was admitted with abdominal tumor of long standing, and having a completely ovarian history, but which she stated to have increased lately, and from finding that the breasts were now secreting milk, I was led to suspect the possibility of pregnancy: however, Dr. Ashwell examined by the vagina, and no alteration was discoverable in the neck of the uterus. The tumor went on increasing, on one side more particularly; and in four months after, I again requested Dr. Ashwell to examine: and he then had no doubt that pregnancy was advancing; and shortly afterwards the motions of the child became very perceptible to the hand placed externally. In due time she was removed into another ward; had a natural and easy labour; but the ovarian tumor remained unaltered; and she was transferred back again, under my care.

With regard to our PROGNOSIS, the ultimate prospect is, certainly, most unfavourable. We find, in the cases above recorded, that the malignant ovarian tumor, left to itself, often destroys life in a short time, partly by irritation, but probably in a great degree by the mechanical pressure it exerts (Cases 10 and 11). That if paracentesis is performed, life may be prolonged; but that sometimes, from the inflammation excited by the circumstances attending the operation (Cases 6, 12, 14, 15, 17, &c.), and sometimes without any discernible inflammation (Case 9), death takes place. That in other cases, the malignant disease seems to undermine the constitution, and gradually leads to a fatal result. (Cases 23, 24, 25, 26.) That, occasionally, the internal rupture of the cyst produces death. (Cases 16, 18, 19.) But still, with such a discouraging prognosis before us, we have every reason to feel that the interposition of our remedial means is productive of great alleviation, and is capable of prolonging life; and although the duration of this disease is often limited to months, and still more frequently to a very few years, yet instances are not wanting, in which ten, twelve, or a still

greater number of years have been passed in tolerable com-
fort: and in giving our prognosis, we should suffer ourselves
and our patients to have the full benefit of the hope which
such cases are calculated to inspire.

I believe, as far as CURE is concerned, the malignant ovarian
dropsy admits of none; unless we may consider the excision of
the tumor in that light: and this must ever be so doubtful an
operation, surrounded by so much darkness, and attended
with so much danger, that I can only look upon its happy
event as the fortunate result of a bold and hazardous enter-
prise, which should not tempt us to adopt it as a rule of
practice.   When we consider the nature of the affection, we
are at once prepared to find that all remedies specifically
directed to its cure will prove useless.   It is truly a malignant
disease; and though it usually assumes one, and that a milder
modification, in preference to the rest, is not unfrequently
found degenerating into the worst and most destructive forms
of the fungous and cerebriform cancer; and it undergoes
those changes by such insensible degrees, that it is impossible
to draw the line, and deny a malignant character to one, while
we grant it to the others.   But though we confess that we have
no remedies to act directly upon the disease, a good deal may
undoubtedly be done in regulating the various processes of
the economy, so as to maintain the general health in a state
unfavourable to the rapid development of the disease ; and
for this purpose we have to reinstate the natural secretions,
to subdue excessive action whether local or general, and to
maintain the strength.   It is not necessary, in this place, to
enter into all the minutiæ of such treatment—it is enough
to say, that occasional local bleedings, blisterings, and counter-
irritation, mild bitters and tonics, the taraxacum and the
sarsaparilla, the alkalies, and a variety of other remedies,
with conium, hyoscyamus, and different narcotics, afford the
means, when varied according to circumstances, of preventing
inflammatory action; of allaying the irritation, which is often
discoverable by the pulse, and sometimes by the expressions
of pain; and at the same time of assisting to maintain the
powers of the system.
    Iodine is one of the remedies which have been much

recommended by some writers; but if administered, it must be done with all that precaution which naturally suggests itself, when employing a remedy capable of promoting the absorption of the natural structures, fully as much as it does of those tissues dependent upon malignant disease, and which sometimes leads to the most alarming state of nervous depression.

Dr. Barlow, of Bath, has published some cases, in which repeated bleedings from the arm, with leeching and cupping, seemed to have retarded the progress of the swelling, and almost anticipated that proof of the existence of the ovarian disease: but I must confess, that however influential remedies may be in preventing the yet unformed disease, or in checking its progress, I am always inclined to look with doubt upon cases of supposed cure after the disease is once confirmed; as I think there is reason to suppose, that, from its very beginning, its character is often truly specific and malignant.

In the midst of our attempts to retard the progress of the disease, the question of paracentesis presents itself. There are, I believe, a few instances on record, where this operation has apparently been followed by complete cure: there are certainly cases in which the rupture of the cyst internally has been followed by no re-accumulation of the fluid: but whether, in these cases, the disease has been any thing more than a simple serous cyst, is doubtful. We have, however, at all events, great reason to believe, that, in some cases of a truly malignant character, an individual cyst has contracted after the fluid has been withdrawn, though other cysts in the same diseased mass have rapidly increased (Case 7). These considerations might lead to an expectation that paracentesis would prove more than a merely palliative remedy; but, unfortunately, this conclusion is not countenanced by experience; and although, by some rare combination of circumstances, the withdrawal of the fluid may be followed by a long respite, or even an apparent cure, yet we cannot look upon it, generally, in any other light than as a means of present relief.—It is, however, an operation to which we must in many cases have recourse, if we would prolong the lives of our patients; and one or two important questions present themselves in connection with it: first, as to the time; and then as to the manner of performing

the operation. As to the time, it may be done early, while yet the tumor is small, and just rising from the pelvis: it may be done when the tumor is become large, occupying apparently the whole abdomen, but still attended by no great inconvenience, nor affording any apparent obstruction to the action of the viscera, or the abdominal circulation : or, thirdly, it may be deferred till the inconvenience is become very great, the stomach compressed, the intestines impeded, and the chest encroached upon. Of the two first of these I have very little experience; partly because cases of this kind are not generally brought under the notice of the physician in the early stages of their progress; and partly, because I always feel reluctant to recommend an operation, and the patient is unwilling to submit to one, when there is no obvious necessity, and when there is no imminent inconvenience to be removed. Besides this, our diagnosis is more certain as the disease becomes more advanced; and the operation is connected with less hazard at the time, and probably less danger from after-inflammation. Although, therefore, I have had but very little experience in early operation, yet, as I see no reason to suppose that by drawing off the fluid we shall change the malignant nature of the disease, but may probably accelerate its progress, I do not think it advisable to have early recourse to paracentesis. I have been much more in the habit of abstaining from operation, as long as the patient herself feels no urgent inconvenience; provided there is no direct evidence, in the interruption of functions, that the pressure is doing essential injury. The timidity of some patients, however, will render it necessary to interpose with strong advice; for there is no doubt that death will take place, and sometimes rapidly, from the effects of the pressure, and the irritation of the unrelieved tumor; as was exemplified in Cases 10 and 11 : and I conceive that the time for the operation is arrived when the tumor pretty fairly occupies a large portion of the abdomen, giving the appearance of pregnancy advanced to the last months, and before any material mischief seems to threaten, either to the surrounding viscera or to the parietes of the tumor itself: for there can be little doubt that the forcible distention of the sac, continued beyond a certain limit, will endanger its inner surface, and perhaps prove one

cause for those ulcerative changes which often take place
and are the source of great constitutional irritation, and of
de ath,as seen in several of the foregoing dissections.

Supposing the period for performing the operation to be
agreed upon, another question arises, as to the part in which
the puncture should be made. As the tumor is probably one
of complicated structure, we must, by the hand, and by per-
cussion, ascertain, as far as possible, the part in which the
parietes are yielding, and in which the fluid is chiefly accumu-
lated; for I have known instances in which the operator has
been foiled, and even obliged to make a second puncture, from
having pushed the trochar into a solid mass: and even when
distinct fluctuation has been ascertained, the thickness of the
fluid has sometimes prevented its passing by the puncture; or,
by opening into some secondary cyst, a few ounces only have
been drawn off, to the great disappointment of the patient,
who had made up her mind to the operation under the full
expectation of being relieved of a large part of the burden
with which she was oppressed. In one of the foregoing
cases (Case 15), another source of disappointment has been
seen, from the trochar passing into a firm band formed
by the broad ligament and the Fallopian tube stretched
over the tumor; and affording such resistance, that the
instrument pushed the parietes of the tumor before it; and
when withdrawn, under the belief that it has gone deep into
the cyst, no fluid escaped. Very attentive manual examina-
tion might possibly, in general, prevent such an accident; and
there is scarcely any rule by which the operator can be
directed, as these bands may cross the tumor in various di-
rections: and in one of the cases mentioned in this paper
(Case 26), it actually ran to be attached to the lobe of the
liver.

It is right, before operating, to be quite sure that the
bladder is empty; and, of course, enlarged veins must be care-
fully avoided: and, in general, it will be right to examine the
state of the uterus per vaginam; more particularly if it be the
first time that the operation has been performed. Should the
sensation given by pressure on the abdomen lead to the
belief that adhesions have taken place between any portion of
the cyst and the parietes, it will be well to select this part for

the operation, as we shall thus avoid one important source
of danger—the escape of a portion of fluid into the abdominal
cavity : and if in any case we might allow of a fistulous open-
ing being established, this is it. (Case 8.)

Another very important point, is the quantity of fluid which
should be drawn away. Some there are who think that it is
most advisable to take away but a small portion of the whole,
just sufficient to relieve the urgent oppression; supposing
that by this means the cyst is more likely to contract, and
believing that the fluid does not re-accumulate so rapidly in
this case as where the distending contents are at once with-
drawn. On the whole, however, I generally recommend that
as much of the fluid as possible should be removed; because I
dread, above every other danger, that of a portion of the fluid
escaping into the peritoneum; of which we run a great risk, if
the wounded parietes of the tumor fall in upon a considerable
quantity of fluid : and in order to avoid this still further, a
regular gentle pressure should be maintained, as is usual
during and after the operation in ascites; and for some days
the most perfect tranquillity should be enjoined, the patient
being treated like one who is recovering from labour.

There are other diseases to which the ovaries are subject ;
some of which produce manifest tumors, ascending from the
pelvis ; and are therefore by no means foreign to the subject
of the present communication. Most of the enlargements of
the ovaries would appear to be dependent on malignant disease;
such, for instance, as the cellular enlargement, of which mention
has been made in Case 4, and of which a sketch may be seen
in Plate X. Fig. 5 : so likewise the deposit of bony matter in
the ovary, which I have seen associated with the fibrous tu-
bercle of the uterus. But in one rather remarkable specimen
in Guy's Museum, both the ovaries are enlarged to the size
of the kidneys, and are of a solid fleshy consistence. They
had formed distinct tumors above the pubes ; but whether they
ought to be considered malignant or scrofulous, it is difficult
to determine : certain it is, however, that their solid structure
bears no analogy to any thing we usually see associated with
malignant disease in this organ. The short history which
accompanied this preparation, in a letter addressed to the
late Mr. Stocker of Guy's Hospital, is worth preserving ; and

with it I will conclude my present communication on abdominal tumors.

"The woman had borne children; and when passed the "menstrual period of life, was seized with pains which were "referred to the uterus. These continued more or less "acute for two months, when a considerable indurated sub-"stance was perceptible in the regio pubis; referable (as "was considered) to a morbid state of the uterus. After "this time, a difficulty in making water added greatly to "her sufferings; indeed it amounted to inability, in the "erect position of the body; but the recumbent posture sen-"sibly removed the only impediment to its discharge. From "anxiety, which her intolerable pain induced, or from a com-"bination of circumstances, she became the most emaciated "object I ever witnessed. Jaundice supervened, attended "with ascites; and in this precarious situation, some one, "being consulted, took up the idea of its being a scirrhous "liver, and recommended a moderate ptyalism to be raised "and supported. The hardened substance before mentioned "was considered by him as a continuation of the liver. Mer-"cury, however, was only given in small quantity; and soon "after she began its use, death closed the scene.

"I solicited an examination of the body; and have sent you "the enlarged ovaries. (Plate X. Fig. 8.) The liver was perfectly sound."
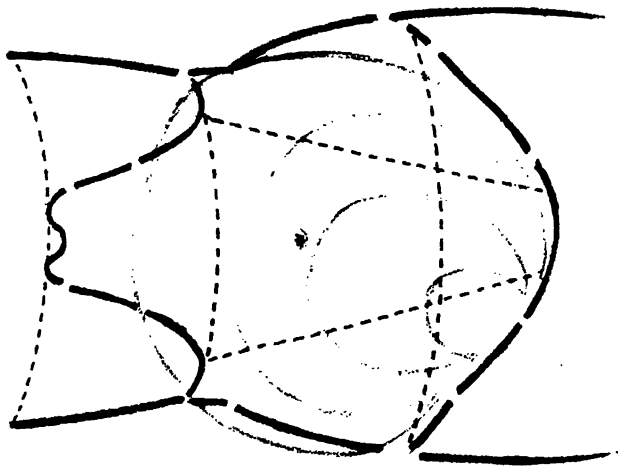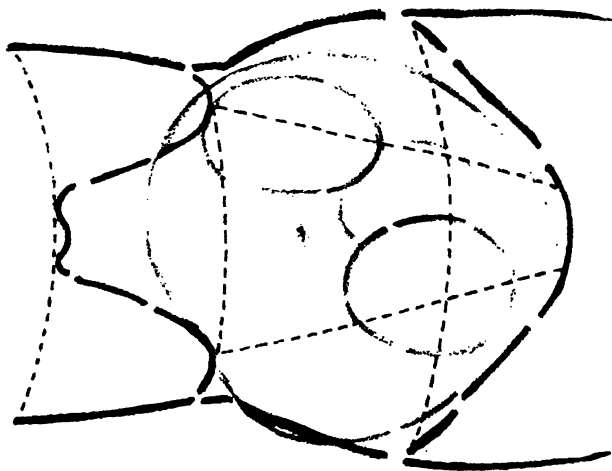
Plate I

Fig 1

Fig 2

Fig. 1.
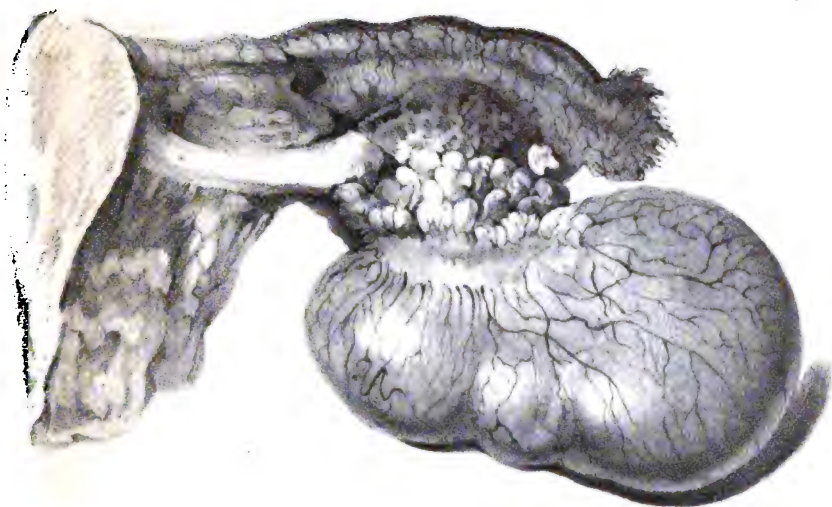
Fig. 2.
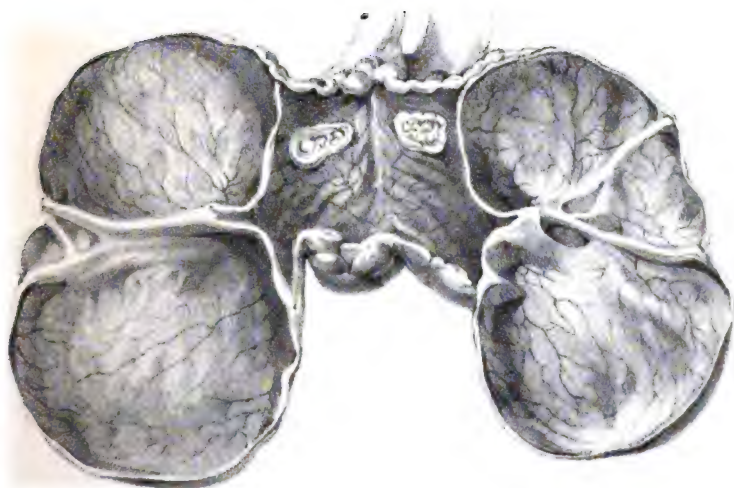
PLATE III.

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Represents one of the diseased masses which are frequently found connected with the parietes of the large cysts of ovarian dropsy. It projects from the inner surface of the cyst, originating between its laminæ: and a process of sloughing having taken place in the lamina by which it was retained, a crescentic margin is seen formed around it, with a clean firm edge. The diseased mass was itself a fungoid growth, probably formed originally of more transparent cysts filled with glairy mucus, now become opaque and cerebriform. (Case 5. p. 199.)

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PLATE IV.

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Fig. 1. The incipient stage of a tumor analogous to that represented in Plate III. and taken from the same ovarian cyst. In this case, the inner lamina had been divided by the scalpel. A tenacious mucus distended the cavity ; but when this was removed, a transparent vascular cyst was seen projecting from the bottom. (Case 5. p. 198.)

Fig. 2. A portion of the internal surface of a large malignant ovarian cyst, shewing a peculiar but not unusual reticulated appearance, apparently the result of the thickening of cellular tissue; and between the meshes may be seen occasionally small cysts projecting. (Case 6. p. 202.)

Fig 1.
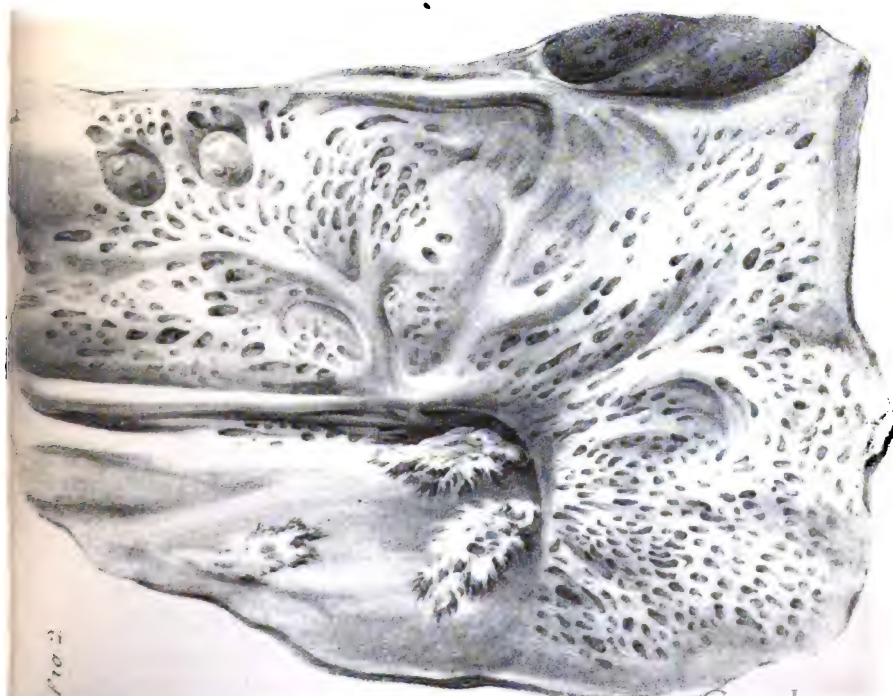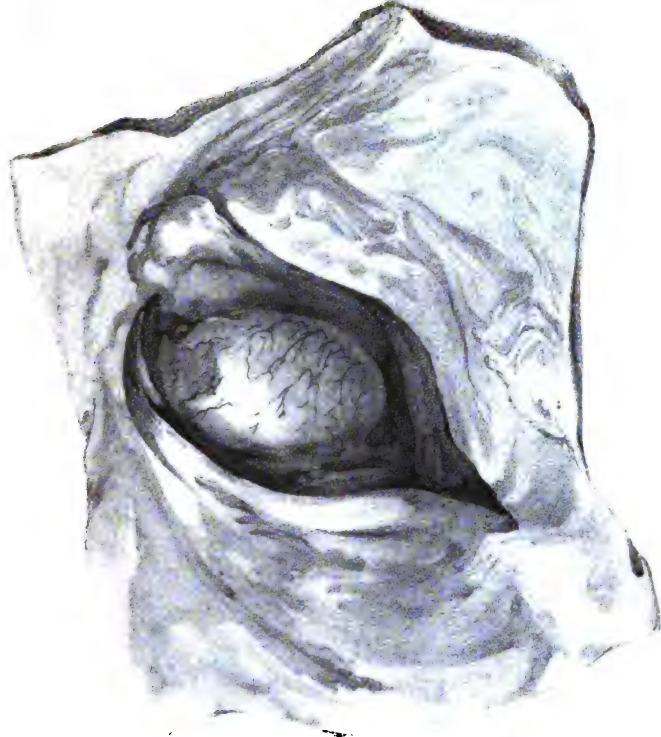
Fig 2.

PLATE V.

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Represents a mass of cysts included between the layers of a large
ovarian cyst, apparently owing their peculiar form and arrangement,
in some degree, to the cellular structure connecting the layers. Some
of the cysts are complete, without any opening; but many communi-
cate freely one with the other by openings only partially closed by
folds, some of which form bands and imperfect septa through the
mass. (Case 6. p. 202.)

PLATE VI.

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Represents the abdomen distended by an ovarian cyst; which, not-
withstanding its enormous size, interfered little with the posture as-
sumed by the patient in bed. The surface was covered by a network
of distended veins, in consequence of the pressure of the tumor on the
veins internally. They conveyed the blood from the iliac to the inter-
costal veins chiefly; and as the cava is generally simply compressed
in these cases, and not obliterated, the circulation is partially re-
stored to its natural course, when the fluid is withdrawn and the
pressure removed. (Case 7. p. 205.)

Plate VI

PLATE VII.

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Fig. 1. represents the ovarian tumor when the integuments had been removed.   (Case 7. p. 206.)

Fig. 2. shews the situation which the abdominal viscera had occupied, in consequence of the pressure of the ovarian tumor, during a period of several years.   When this sketch was taken, nothing had been done beyond the careful removal of the tumor, that no disturbance might be given to the viscera as they lay.   The liver was seen pushing the diaphragm as high as the third rib.   The stomach and intestines, greatly reduced in size, occupied the posterior and upper part of the abdomen, where they afforded hollow sound, on percussion ; and where alone the movements of the intestines were felt by the patient.   (Case 7. p. 207.)

Fig 1

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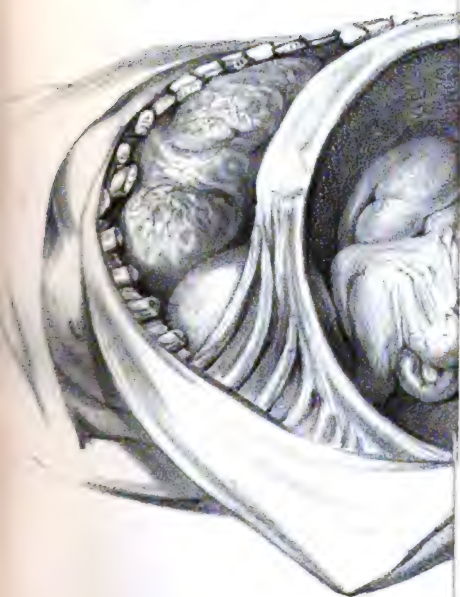
PLATE VIII.

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Represents the appearance of an ovarian tumor, when the integu-ments had been carefully removed; and is chiefly given to illustrate the difference of the form which the abdomen assumed, and its irre-gular shape; and also as an instance of the rapid growth which sometimes takes place in the ovarian tumors: for the disease in this case had not attracted notice above two years, at the utmost. On one portion of the right side of the tumor, crepitation had disclosed the existence of adhesions; and the cellular membrane forming them is marked in the sketch. (Case 10. p. 215.)

PLATE VIII

PLATE IX.

Shews the appearance of the abdomen in a case where an ovarian cyst had been ruptured by ulceration of the inner membrane, during life. The intestines had been forced by the tumor, when fully distended, into the upper and posterior part of the abdomen; and had not recovered their natural situation; the cavity having been filled by the fluid which escaped from the ruptured cyst. (Case 21. p. 240.)

PLATE X.

Fig. 1. Ovary and Fallopian tube; from which are seen arising three cystiform bodies, possibly the incipient state of the simple ovarian cyst. (P. 179; natural size.)

Fig. 2. A simple cyst, developed in the broad ligament of the uterus: the Fallopian tube, which is attached to it, has been laid open : it is doubtful whether this cyst may not depend on disease of the ovary itself, as that organ is not found in the preparation. (P. 180.) The cyst, as preserved in the Museum, is about four inches in its longest diameter.

Fig. 3. A simple cyst in the broad ligament; which is evidently unconnected with the ovary, as that organ is perfect. (P. 180.)

Fig. 4. A greatly diminished sketch of a large compound ovarian cyst, laid open. This is drawn with the design of giving a general view of the structure very frequent in this disease, where the whole diseased mass appears divided by septa; and in the compartments formed by them, when the mucilaginous secretion is removed, numberless small cysts display themselves. What part of this structure can be accounted for by the increase of natural cellular membrane, and what part is owing to peculiar growth, is no easy problem to solve. The preparation from which this sketch is taken, is preserved in Guy's Museum, and is above a foot in diameter. (P. 182.)

Fig. 5. The uterus and ovary, from a patient who laboured under schirrous mamma, and in whom other organs were similarly diseased. The ovary appears to shew the early stage of the malignant ovarian disease; and several cysts are already formed. The uterus is also affected, having a fibrous tubercle in the parietes of its fundus : and another obtruding on the cavity, which it distends. (Case 4. pp.195, 266.) This preparation is preserved in Guy's Museum; and the length of the diseased ovary is about three inches and a half.

Fig. 6. The internal view of a cyst, believed to be ovarian, which had emptied its contents into the colon, at the point where the bristle is introduced. Its surface was curiously corrugated, apparently from the contraction which had taken place in the cyst since its contents had found an egress. (Case 13. p.221.) This cyst, which is preserved in the Museum of Guy's Hospital, is about six inches in diameter.

Fig. 7. A reduced sketch of a remarkably hard ovarian cyst, which occurred, in combination with ascites, in a case where the peritoneum was so much thickened as to give to the whole abdominal cavity the character of a cyst. The ovarian tumor, when opened, proved to be filled with a closely-compacted growth, resembling a head of cauliflower, which sprung from one portion of the cyst more than from the rest : but the exact nature of this growth, though it appeared malignant, is not ascertained. The tumor, which is preserved in Guy's Museum, is nearly fourteen inches in its largest diameter. (P. 260.)

Fig. 8. represents the uterus, with the two ovaries greatly enlarged, independently of malignant disease ; each ovary being nearly six inches in its longest diameter. (P. 267.)

Fig 7

Fig 6

Fig 5

Fig 6
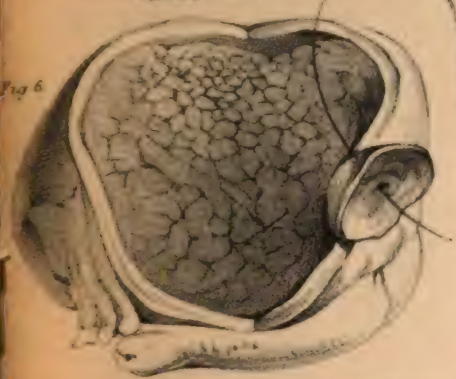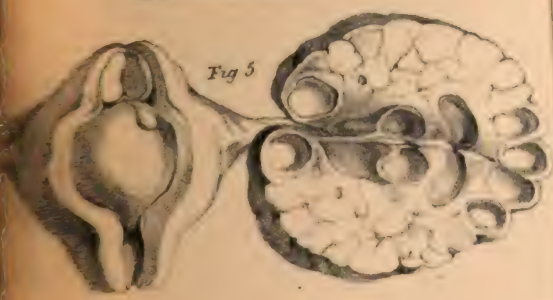
A CONTRIBUTION

TO

THE PATHOLOGY

OF

CONGENITAL DEAFNESS.

BY EDWARD COCK.

In glancing at the history of Medicine and Surgery from the earliest ages down to the present time, we shall find, that while every other department has continued to claim the attention of scientific and intelligent men, the pathology and treatment of diseases of the ear has, until lately, been almost wholly neglected; — that while our knowledge of disease affecting every other organ and tissue of the body has expanded with a steadiness and certainty commensurate with the skill and labour which have been brought to bear on the subject, the ear still remains one of the strong-holds of the empiric, its morbid alterations but little understood, and their remedial treatment, for the most part, rather avoided than studied by those who would be most competent to undertake their management on scientific and rational principles *.

Within the last few years, the works of Itard, in France, and Kramer, in Germany, have thrown much light on the diseases of the ear: and as the subject is now beginning to claim some attention in our own country, I am induced to contribute my mite of information on that branch of aural pathology which hitherto seems to have escaped the attention, or eluded the research, of both earlier and contemporary investigators: I mean, the condition of the ear, in cases of congenital deafness.

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* It is much to be regretted, that the few aurists who in this country form honourable exceptions to the above observation, have not been induced to publish the result of their experience and practice in this obscure and difficult branch of the profession.

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The cause of congenital deafness has been almost universally referred to some supposed abnormal condition of the auditory nerve, inducing paralysis; although there are certainly but very few cases upon record in which the nerve has been found altered in its size or texture, unless through the agency of tubercles, hydatids, or some other cause producing mechanical pressure, or lesion of its substance.

Saunders, in his book "On the Anatomy and Diseases of the Ear," gives but one case as affording an explanation of the cause of congenital deafness. In this instance, the labyrinth was occupied by a soft cheesy substance; although I think it may be questioned whether this was an original formation, or a subsequent deposit of scrofulous matter *.

Itard, who has published a voluminous work on the diseases of the ear, mentions two cases of congenital deafness, in which the tympanum was filled with a calcareous deposit: also two others, in which a morbid growth had taken place from the membrane lining that cavity—"végétations produites par la membrane qui la tapise": and a fifth, where a gelatinous secretion occupied not only the tympanum, but also the canals of the labyrinth. He likewise speaks of a child, where the auditory nerve was converted into a substance resembling mucus; and of a man, in whom it was shrivelled up, and reduced to a mere thread.

Pinel relates the result of dissections, in which the water of the labyrinth was altogether deficient, leaving the cavities dry and empty; but these would appear to be cases where deafness occurred in after-life, and not where the defect was co-existent with birth.

Accounts are also on record, of congenital deafness being caused by an extension of the true skin over the membrana tympani, by the presence of polypi in the meatus externus, &c.

Dr. Kramer, of Berlin, who has certainly written the most practical work on acoustic medicine and surgery, does not appear to have extended his researches to the causes of

* When a section is made through the internal ear by means of a fine saw, the mixture of the bone-dust with the water of the labyrinth produces a soft paste, which exactly resembles the cheesy matter described by Saunders; and I think it is not improbable, that he inadvertently mistook this factitious ubstance for scrofulous deposit in the vestibule and cochlea.

congenital deafness, and therefore throws no light on the subject.

Through the kindness of Mr. Watson and the Medical Officers of the Asylum for Deaf-and-Dumb, I have been enabled to inspect the bodies and examine the temporal bones of most of the children who have died in that institution during the last six years. The facts elicited from the dissection of the first six cases have already appeared in the Nineteenth Volume of the Transactions of the Royal Medical and Chirurgical Society. In three of these cases, I discovered in the organs of hearing such palpable deviations from the normal structure, as served to convince me that a congenital malformation does exist much oftener than has generally been supposed; and that a careful investigation of the auditory apparatus may, in many instances, throw light upon the pathology of deafness from birth. Since the publication of the Paper, several subsequent examinations have afforded some still more curious results, which may possibly open a wider field for speculation to the physiologist, as well as to the morbid anatomist. For the purpose of rendering the present article more complete, and laying before the reader, in one view, the whole series of malformations which I have discovered from time to time, I shall take the liberty of extracting from the Medico-Chirurgical Transactions the results of my earlier labours, and prefixing them to the detail of the cases which have come subsequently under my observation.

" The subjects examined were all children who died of strumous diseases of the thoracic and abdominal viscera. In three instances, one or both ears were the seat of scrofulous ulceration, affecting the tympanum and meatus externus, with partial destruction of the membrana tympani. In one case, the cavity of the tympanum, together with the mastoid cells, was completely filled with the thick cheesy deposit of scrofula, whilst a similar affection pervaded the whole can-cellated structure of the petrous bone. The connexions of the ossicula auditûs were destroyed, but the bones themselves remained entire. I merely mention these facts as indicating the strumous habit of body, which I believe prevails very generally among the deaf-and-dumb: for as these affections could have existed but for a short time previous to death,

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they can hardly be supposed to have had any connexion with
the congenital defect in the organ of hearing.

" I may also remark, that, in all the cases examined, the
petrous portions of the temporal bones exhibited more than
the usual varieties of size and shape.   In some, the bone was
so deficient in particular spots as barely to cover the internal
cavities; whilst in others there appeared a preternatural
osseous development.   In one instance, the petrous bone of a
child, twelve years old, exceeded in size, hardness, and com-
pactness of structure, that of any adult which I have witnessed.

" The malformation which I discovered in two instances
may be described in a few words.   It consisted in a partial
deficiency of two of the semicircular canals.   The extremi-
ties of these tubes opening into the vestibule were perfect;
but the central portions were impervious, or, rather, did not
exist at all.   In the first case, I had the opportunity of ex-
amining the ear from one side only *.
The vertical and oblique semicircular
canals were both impervious at their
central portions.   The accompanying
diagram will render the state of the
parts easily understood; making some
allowance for the false perspective which
I have had recourse to, in order to ex-
hibit all the canals in one view.
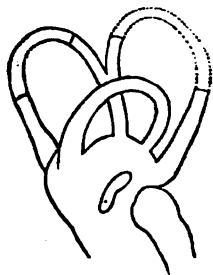
" The defective portions of the canals are traced out with
dotted lines.

" In the second case, both ears were
examined.   On the right side, the mid-
dle portions of the oblique and vertical
canals were wanting, the bone presenting
an appearance like that already described.
On the left side, the horizontal and ver-
tical canals exhibited a similar imper-
fection.   The scala tympani, likewise,
was terminated, at its larger extremity,
by a bony septum, which separated it from the tympanum, and
occupied the situation of the membrane of the fenestra rotunda.

* This examination was made in the month of November 1832.

" In the third case, not a vestige was to be found of the fenestra rotunda on either side; the usual situation of the membrane being occupied by solid bone.

" The temporal bones of this child were exceedingly large, although soft and spongy in texture. The cavities were more than usually capacious; and the Eustachian tubes presented a remarkable development, being three or four times larger than common. On one side, the aqueduct of the vestibule readily allowed the passage of a large bristle: on the other side, the canal could not be traced through the bone, although its two extremities were more than usually expanded. Suppuration had taken place in one tympanum.

" With the exception of these malformations, and the scrofulous affections of the tympanum mentioned above, which were probably of recent occurrence, no deviation from the healthy state could be discovered in either of the five subjects examined. The Eustachian tubes were pervious; the bones, muscles, and membranes, entire and natural: the labyrinths were filled with their transparent fluid. In no instance did the auditory nerve present any peculiarity, although carefully traced from its origin to its distribution. The chorda tympani was present in every instance; but I cannot vouch for the integrity of all the little nervous fibrillæ, which pass into the tympanum, and ramify on its walls, requiring the aid of a microscope for their dissection.

" In addition to these three cases of malformation, I may state a fourth; which was dissected by my friend Mr. Dalrymple, and is now in his possession. In this instance, the aqueduct of the vestibule was so. large as to admit the passage of a small probe; whereas, in the natural state, a fine hair can with difficulty be introduced into the canal."

In the same Number of the Medico-Chirurgical Transactions will be found a communication from Mr. Thurnham; which I read with considerable interest and satisfaction, since it describes a similar malformation of the semicircular canals discovered in the ear of a deaf-and-dumb person. I am not aware of any other investigations having been made in this country.

I have regretted, that, in the examination of the different ears which afforded the above results, the cochlea was not in every instance traced out with all the care that might have

been bestowed upon it: for, as in the outset of my researches, my attention and views were more particularly directed to the tympanum and its appendages, it was not until I became aware of the abnormal condition of the semicircular canals that I determined, in every future case, to undertake a deliberate and patient investigation of the labyrinth. It is therefore possible, that certain deviations in the organs may have been overlooked, which would not now escape my observation.

Since the year 1835, the Asylum for Deaf-and-Dumb has furnished me with seven additional post-mortem examinations, the particulars of which I will now proceed to describe.

CASE 1.

A boy, 12 years of age, who had sunk rapidly under fever, attended by acute cerebral symptoms.

Great vascularity throughout the brain and its membranes: effusion between the arachnoid and pia mater, and within the ventricles. The origin of the auditory nerve presented nothing unusual.

The left temporal bone.—The tympanum was completely filled by spongy and highly-vascular granulations, which appeared to grow from the mucous membrane lining the cavity; and to derive their vessels, which were numerous, large, and injected with blood, from the same source. This adventitious growth also occupied the mastoid cells, extended into the Eustachian tube, and adhered closely to the membrana tympani and the chain of small bones: it had no malignant character, but bore considerable resemblance to the exuberant granulations which are so abundantly produced after fracture of the scull, attended with lesion of the brain, or after-abscess of the testicle. The petrous bone was remarkably ill shaped, very narrow from before to behind: the jugular fossa exceedingly large and excavated, so as to encroach upon the tympanum and Fallopian canal; the latter of which was laid open towards the fossa, when the periosteum was removed. The groove for the superior petrosal sinus was very broad and deep: in fact, the petrous portion was so scanty in its dimensions, and presented so little solid bone, that it was evident, on viewing its exterior, that the semi-

circular canals could not exist in their perfect state. The meatus auditorius internus was represented by a narrow slit; and the portio mollis became pulpy and transparent, as it descended into the canal. On cutting open the bone, the labyrinth presented the following appearances. The auditory canal, instead of being terminated by the cribriform plate forming the base of the modiolus, opened at once into a cavity of a somewhat conical shape; communicating with the vestibule by a very large aperture; and also with the tympanum, by means of the fenestra rotunda; through which last, the vascular granulations already described had found their way. This cavity, in fact, represented the mere external shell of a cochlea, but without a vestige of modiolus, spiral lamina, or scalæ: the auditory nerve entered it, and apparently expanded on its walls. The vestibule, or what answered to it in situation, was rendered irregular; on the one hand, by forming a continuous cavity with the imperfect cochlea; and on the other, by extending itself outwards, so as to include that portion of bone usually embraced within the concavity of the horizontal semicircular canal. Not a trace, however, existed of either the horizontal or the oblique canal: the anterior opening of the vertical canal alone was present; but the canal itself suddenly stopped, after having completed about half its natural course. There was no aquæductus vestibuli. (Vide Plate, Fig. 1.)

The right temporal bone.—The tympanum was occupied by an adventitious growth, precisely similar to that on the left side. The petrous bone was more regular in its external configuration. The aquæductus vestibuli consisted of a very large funnel-shaped canal; terminating, in the vestibule, by an oval opening, sufficiently wide to admit the eye of a small probe. The semicircular canals were perfect; and the vestibule natural as to size and form, but communicating, by a very large opening, with a cavity somewhat resembling that on the left side, and representing the shell of a cochlea which contained the rudiment of a modiolus (that is to say, the base shutting out the cavity from the meatus internus, and allowing the passage of the auditory nervous filaments), and an attempt at the formation of a spiral lamina, which, however, did not make a complete turn, and consisted chiefly of

membrane, which disappeared on the parts becoming dry from exposure. The fenestra rotunda could hardly be said to exist. (Vide Plate, Fig. 2.)

Case 2.

A boy, about twelve years old, who had been deaf and dumb from birth, and subject to epileptic fits.

All the vessels of the body, but particularly those about the head, were remarkably distended with fluid blood, which flowed copiously from every incision. The brain was exceedingly hard and firm, resembling cheese in its consistence: its vessels were strongly injected, and the ventricles contained a considerable quantity of fluid; but no tumour, or other unnatural appearance, could be discovered within the cranium. The mesentery was studded with innumerable bony deposits, contained between its layers; but which, apparently, had not interfered with the function of the lacteal absorbents, as the lad was remarkably well grown, and stout for his age. The temporal bones were exceedingly large, massive, and heavy; and in this respect would have been remarkable, had they belonged to an adult instead of a child. The cancellated structure which generally exists in the petrous portion was entirely deficient; and the bone presented, throughout, a dense compact texture, of almost iron hardness, and resembling the closest-grained ivory. The meatus externus, on both sides, was partly filled with dry inspissated cerumen, and the position of the membrana tympani was nearly horizontal.

Interior of the right ear.—The cavity of the tympanum was completely filled with dense fleshy granulations, adhering most firmly to the walls, completely enveloping and concealing the bones, adapting themselves to all the crevices and irregularities, and extending into the mastoid cells and the commencement of the Eustachian tube. A small quantity of thin purulent fluid escaped, when the roof of the tympanum was removed. The membrana tympani was exceedingly convex, being drawn inwards until it nearly touched the promontory; thus diminishing the size of the cavity, and pushing the bones out of their place, so that the extremity of the manubrium of the malleus and the long crus of the incus were in close contact, and carried to the edge of the

fenestra ovalis. I could not discover any vestige of the sides of the stapes, although the plate of bone forming its base still continued to occupy the foramen ovale. I should, however, remark, that the extreme difficulty of removing the adventitious growth which surrounded the bones rendered the precise state of the stapes somewhat uncertain; and it is just possible that it might have been broken up, in the attempt to clear the tympanum from the granulations which filled it. The vestibule was spacious, and contained the usual limpid fluid; the semicircular canals were pervious and natural; the entrance to the cochlea presented the ordinary appearance, when viewed from the vestibule, but terminated suddenly, in a blind extremity about a line from its commencement. Of the cochlea itself no trace existed, its situation being occupied by solid hard bone. The fenestra rotunda, when traced from the tympanum, terminated in a minute cavity; which might be considered as the rudiment of a scala tympani, and into which the granulations already alluded to had entered. The auditory nerve was remarkably hard and small, and was entirely distributed to the vestibule; that portion, which in the normal condition pierces the modiolus to supply the cochlea, being, of course, deficient.

Interior of the left ear.—The tympanum presented nearly the same appearance as on the right side; with this addition, that the membrana was closely adherent to the promontory, producing a still greater diminution in the size of the cavity, and a greater distortion of the bones from their natural situation. The incus was anchylosed to a little spicula of bone, which projected from the inner wall of the tympanum, just above the Fallopian canal. The labyrinth presented nothing unusual, if we except, that the modiolus of the cochlea was smaller than natural, and that the granulations from the tympanum had passed through the fenestra rotunda into the commencement of the scala tympani. The auditory nerve was small and hard, by far the greater portion of it going to the vestibule.

CASE 3.

A boy, between 12 and 13 years of age, who died of mesenteric disease, accompanied by extensive ulceration of the mucous membrane lining the cæcum and ascending colon.

The temporal bones were well formed, as regarded their external configuration; and the internal organs of hearing presented no appreciable deviation from the normal condition.

Case 4.

A girl, 13 years of age, who died of phthisis.

The right ear.—The tympanum partly filled with soft vascular granulations; a muco-purulent fluid occupying what remained of the cavity. The Eustachian tube very large, and containing a quantity of semi-inspissated mucus. Bones, muscles, and nerves, perfect. Vestibule spacious, semicircular canals perfect, with very large ampullæ. The communication between the vestibule and cochlea wider than usual. The cochlea was natural, as regarded its external configuration or shell; but its interior was very deficient. Thus, on tracing the scala tympani from the fenestra rotunda, it was found to take about half a turn round the base of the modiolus, and then terminated in a blind extremity. The scala vestibuli, on the other hand, formed about one-third of a turn; and then opened into a cavity which constituted the remaining part of the cochlea, as represented by its external shell. In fact, the base of the cochlea alone was perfect, the remaining portion consisting merely of the cavity just mentioned: not only was the greater portion of the spiral canals deficient, but the blind extremity of the scala tympani prevented any continuity or communication between them.

The petrous bone, more especially in the neighbourhood of the tympanum, was unusually loose and cellular, presenting numerous irregular cavities, which apparently communicated with the tympanum, and were filled with the same muco-purulent fluid: they seemed a sort of extension of the mastoid cells.

The left ear.—Petrous bone irregular in shape; the meatus externus remarkably narrow, representing an elongated ellipse, when cut across. No external appearance of aquæ-ductus vestibuli. The lining membrane of the tympanum thickened, but not granular; the cavity, together with the mastoid cells and Eustachian tube, filled with sopy, adhesive, and slightly purulent mucus. The interior of the vestibule presented but four openings of the semicircular canals,

instead of five; that which is common to the posterior extremity of the vertical, and the superior extremity of the oblique, being deficient. On tracing the vertical canal from its anterior opening, it was found to terminate, not by returning to the vestibule, but by becoming continuous with the upper part of the oblique canal, which latter opened below, as usual. The two canals, thus united, formed one irregular tube, which extended across the superior and posterior part of the petrous bone, and presented the appearance indicated in the accompanying diagram. The cochlea presented much the same appearance as on the right side; the lamina spiralis making about half a turn round the base of the modiolus, and separating the scala tympani (which reached to about the same extent) from an irregularly-shaped cavity into which the scala vestibuli opened soon after leaving the vestibule. (Vide Plate, Fig. 3.)
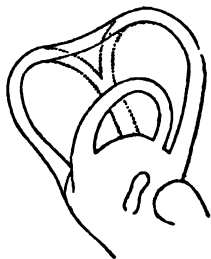
<center>CASE 5.</center>

A boy, 11 years old, who died of tubercular phthisis.

The entire temporal bones, but more especially the petrous portions, were most remarkable for their enormous size. In development, solidity, and weight, they exceeded any that I have ever seen. They were totally destitute of the usual cancellated structure; and the different cavities lay deeply imbedded in a thick mass of compact bone, the excessive hardness of which rendered the examination a work of great difficulty and labour. The external meatus was small, and contracted on both sides. The jugular fossæ were deep and large. The fossæ for receiving the semilunar ganglia of the fifth pair were also much excavated. On the left side there was a separate canal for transmitting the motor portion of the nerve. On the right side, instead of a complete canal for the passage of the carotid artery, there was merely a groove, which was completed into a canal by the sphenoid bone. On the left side there was neither canal nor groove: the artery must therefore have traversed the sphenoid bone, in order to reach the cranium. The Eustachian tubes were

more circular than common, contracted in size, and very irregular as regarded their bony parietes. This seemed to depend on the great accumulation of bone around them, which encroached on their calibre. The only remarkable deviation from the normal structure observed within the organ was the absence of the stapedius muscle on the right side.

Case 6.

A lad, aged 16, who died of tubercular phthisis.

Both temporal bones were exceedingly massive, and hard in their texture; and very ill-formed, as regarded their external configuration. The tympana were irregular in shape, and their parietes more than usually rough. The Eustachian tubes were small, and irregularly contracted. No decided malformation could be detected in any part of the organ.

Case 7.

A boy, aged 12.

The temporal bones were unfortunately subjected to the action of dilute muriatic acid, for some time previous to examination. This was done for the purpose of softening them, and rendering the dissection more easy. It, however, had the effect of so completely altering and obscuring the interior of the ear, as to render an accurate investigation impossible. The auditory nerves were healthy and natural, and the external configuration of the bones presented nothing unusual. The tympana had partly undergone the granular alteration so often alluded to, but were otherwise in a normal condition. The vestibula and semicircular canals were perfect. The cochleæ were so completely altered by the acid, as to preclude the possibility of detecting any but a very decided malformation; but I am not warranted in saying that they were otherwise than natural.

I have now concluded the detail of facts which have resulted from my inquiries; and can only regret that the physiological and practical inferences to be drawn from them are so few and so vague. I am unwilling to enter into the field of conjecture and speculation; yet, nevertheless, I may venture to throw out a few hints and observations, which may

perhaps be taken up, and turned to some account, by those whose attention has been more exclusively directed to these subjects. The present state of our knowledge respecting the exact function which the different parts of the ear exercise, in the appreciation of sound, is so obscure and limited, that it is almost presumptuous to hazard more than a conjecture as to the effect likely to be produced by the different malformations have just described ; for until we can assign a probable office to the various divisions of this complicated organ, it is useless to attempt going far beyond a mere statement of facts.

The little which is known and acknowledged respecting the physiology of hearing, or which may be demonstrated by the application of certain indisputable physical laws to the anatomical structure of the ear, may be summed up in a few words.

The phenomenon of hearing undoubtedly results from the impression produced by the motion of the fluid of the labyrinth on the expansion of the auditory nerve lining its cavities, and thence propagated to the sensorium. The necessary motion, or undulation, is imparted to the labyrinthine fluid by a series of vibrations emanating from the body which produces the sound (as a bell for instance), and mechanically conveyed to the vestibule. There is no difficulty in tracing the course of these vibratory movements, if we follow the connexion of the different parts of which the ear is composed. Thus vibration is propagated through the air, from the sounding body, to the auricle ; and thence transmitted, through the meatus externus, to the membrana tympani ; while the oscillations produced on this last are again conveyed, by the connecting chain of bones, across the tympanum, to the membrane of the fenestra ovalis, which may be considered as the entrance to, or commencement of, the labyrinth ; one of its surfaces being attached to the base of the stapes, and the other in contact with the labyrinthine fluid. It follows, therefore, that every change which takes place in the form of a bell, when it is struck so as to produce a sound, will be succeeded by a corresponding impulse on the membrane of the fenestra ovalis. Again, if we imagine the cochlea to be unfolded, or deprived of its convoluted form, we shall find that the vestibule, the scala vestibuli, and scala tympani, constitute together a

continuous canal, varying in its calibre at different parts, commencing at the fenestra ovalis, and terminating at the fenestra rotunda ; and, that the sides of this canal are firm and solid, while its two extremities are shut in by yielding structures, viz. the membranes occupying the two fenestræ.   The construction of the labyrinth may be familiarly explained by comparing it to a long metallic tube filled with water, and secured at either end by bladder or caoutchouc.   If an impulse be given to the yielding material at the one extremity of such a tube, the impression must necessarily be conveyed to the yielding material at the other extremity, and the whole column of intermediate water will be put in motion. It has been shewn in what manner vibrations are conveyed to the fenestra ovalis; and there can be little difficulty in conceiving how the impulse produced on the membrane occupying that opening must be propagated through the vestibule, through the scala vestibuli and scala tympani, until it is received on the membrane of the fenestra rotunda.   The motion of the fluid causes a concussion on the nervous expansion lining the walls of the labyrinth; which concussion, being referred to the brain, we denominate ' the sense of hearing.'

In accordance with the physiological explanation just given, the organ of hearing may be said to consist of three parts or sets of structures :—1. The external ear and tympanum, being the apparatus by which vibrations are communicated to the labyrinth, at the same time that they may be altered or modified in their intensity. 2. The water of the labyrinth, which is set in motion by the vibrations so communicated to it. 3. The nervous expansion which surrounds the water, and, appreciating the motion of the fluid, produces the sense of hearing.

It follows, that, for the due exercise of the sense, three conditions of the organ are required :—1. A capability to convey the vibratory oscillations from the sounding body to the labyrinth. 2. That the fluid should be susceptible of undulation. 3. That the nervous expansion should be in a state which enables it to appreciate the motion of the fluid, and transfer the impression to the sensorium.   For the purpose of ascertaining how far the malformations, and morbid altera-

tions, which I have described in this Paper, are likely to interfere with the exercise of either of the functions, I have endeavoured to explain, we may class the different abnormal appearances under the following heads :—

1. An adventitious growth filling up, and thus obliterating more or less completely, the cavity of the tympanum, enveloping the chain of bones, and encroaching upon the openings of the Eustachian tube, mastoid cells, and fenestra rotunda.

2. Deficiency of the fenestra rotunda; thus rendering one extremity of the labyrinthine canal solid and immoveable, instead of yielding.

3. Partial or complete deficiency of the spiral canals of the cochlea.

4. Preternatural enlargement of the aquæductus vestibuli.

5. Deficiency of the semicircular canals.

6. Unnatural solidity or hardness of the temporal bone.

It will be remembered, that, in most of the cases detailed above, several of these appearances existed in combination.

With respect to the granular vegetations occupying the cavity of the tympanum, I think that they would be all sufficient to occasion deafness, by preventing the transmission of vibration from the external ear to the labyrinth; while their presence at the entrance of the Eustachian tube, and at the foramen rotundum, would certainly destroy the function of two parts which are essential to the exercise of the sense of hearing. I must, however, leave the question open, as to whether this adventitious growth was coëval with birth or the period of infancy; or whether, on the other hand, it was a subsequent formation, depending upon and accruing from a prior defect in the sense of hearing, from some unknown cause;—whether, indeed, it supervened upon deafness, and was merely an effort of nature to obliterate a cavity whose function of conveying and modifying vibration had become useless, in consequence of the previous inefficiency of that part of the organ by which the vibratory oscillations were to become converted into sound, and appreciated as such by the sensorium.

With respect to the deficiency of the fenestra rotunda—or, in other words, the substitution of solid bone in the place of

the membrane which, in the natural state, occupies that opening—such a malformation must necessarily prevent all motion in the fluid of the labyrinth, by depriving the labyrinthine canal of one of its yielding extremities, and thus cutting off from the expansion of the auditory nerve that medium of communication (viz. the motion of the water) through which it receives its impression. A similar effect will be produced where the cochlea is entirely wanting; or where the scala vestibuli and scala tympani are merely rudimentary, and do not become continuous with each other.

I will not undertake to decide how far a preternatural enlargement of the aquæductus vestibuli may be in itself sufficient to render the organ of hearing useless : I can only venture upon an explanation why such a malformation may possibly be the cause of deafness. The aquæductus vestibuli may possibly serve the office of a safety-valve to the delicate structure of the labyrinth ; and, under intense vibration, may suffer a small portion of fluid to escape from the vestibule, when the motion imparted to the water through the medium of the fenestra ovalis is so violent as to endanger the integrity of the nervous membrane lining the cavities *: but if the aqueduct be preternaturally large, every, even the slightest, vibration will be attended with a discharge of fluid through its canal ; and thus the auditory impression which, by the agency of the water, ought to be propagated throughout the whole extent of the labyrinth, will reach no farther than the vestibule itself.

I have no explanation to offer respecting the deficiency which I have described as occasionally occurring in the semicircular canals : I cannot even speculate on the subject. The function of these appendages to the labyrinthine canal is, as far as I am aware, totally unknown ; and the effect likely to be produced by their malformation must remain equally obscure. Little doubt, however, can be entertained of their

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* I have not, as yet, been able to determine, to my own satisfaction, whether the aquæductus vestibuli and aquæductus cochleæ are really what their name implies ; or whether, as many anatomists suppose, they are merely canals, traversing the bone, for the purpose of transmitting vessels of the cavities with which they communicate.

importance, and that they are essential, not only to the perfection of hearing as enjoyed by man, but to the appreciation of sound itself, as possessed by inferior beings probably not endowed with the same powers of discrimination; since we find these tubes fully developed in many of the lower animals where the tympanum and cochlea are altogether wanting, or exist only as rudimentary appendages*.

In laying the foregoing facts and observations before my readers, I by no means wish that a greater degree of importance should be attached to them than they deserve. I am aware that they are far from elucidating the pathology of deafness, and that they do little more than throw a ray of light over a subject which was previously involved in almost total obscurity. They may possibly excite inquiry in others; and, eventually, be the means of adding to our stock of knowledge respecting the different forms of this disease. Much remains to be discovered, before the causes of congenital deafness can be satisfactorily explained: for I feel assured, that in some, if not in many instances, the deviations I have noticed are quite insufficient to account for a total privation of the sense of hearing; and the fact of several cases having occurred in which no malformation could be detected, proves that there must be some other defect, either organic or functional, the demonstration or explanation of which has, as yet, eluded our research. Still, although I will not venture to assert that the malformations I have brought to light have been, in any instance, the sole cause of deafness, yet I must believe and maintain, in opposition to the opinion of some, that they form a part of a certain pathological condition of the organ, the seat of which is not sufficiently obvious to be detected; but whether it exists in the brain, or in the temporal bone, or in both, can only be ascertained by future investigation. I utterly reject the idea, that these malformations are mere coincidences, which ought not to be considered as having a reference to the imperfection or annihilation of the sense of hearing—that they are, in fact, analogous

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* For a short sketch of the comparative anatomy of the ear, tracing the development of its different parts through the various classes of animals, see *Medico-Chirurgical Transactions*, loc. cit.

to abnormal deviations in other parts of the body, which are discovered after death, but which produced no symptoms during life, as regarded the functions of the organ in which they occurred. A reference to the series of preparations in museums, my own experience in the dissection of ears, and the evidence of those whose constant occupation it is to prepare anatomical illustrations of the organ, prove, almost to a certainty, that malformation never is found, except in cases of deafness.

Although I cannot flatter myself that the issue of my labours has afforded any information which can be attended with a beneficial result in a practical point of view;—although the establishment of a fact, which has been denied, that congenital malformation may and frequently does exist, would rather discourage us from adopting remedial measures, than serve to indicate any mode of treatment for the relief of the patient;—yet I am not without the hope, that my investigations may still prove of some value, in the hands of those who undertake the treatment of deafness on scientific principles, and with a view to the benefit of their patients as well as their own emolument. I trust they may stir up a spirit of inquiry into the symptoms and degrees of deafness; which may lead to the establishment of a more accurate and efficient diagnosis; and enable the aurist to distinguish between those cases which are irremediable by art, and those which may be expected to derive benefit from judicious treatment. There can be no doubt, that, even in cases of congenital deaf-dumbness, the derangement of the organ, whether functional or organic, may exist in different degrees of intensity; that, in some instances, the mischief consists merely of an imperfection or dulness of hearing, which, from neglect, has entailed the additional misfortune of dumbness on the sufferer; whilst in others it amounts to a total and irremediable privation of the sense. The power of discrimination can only be acquired by the intelligent and scientific aurist, and must be the result of much experience and patient investigation; but the knowledge thus acquired would frequently prove the means of rescuing the hopelessly deaf and dumb from the constitutional injury and bodily suffering consequent upon tedious and painful courses of treatment, indis-

Plate 1.

Fig 3
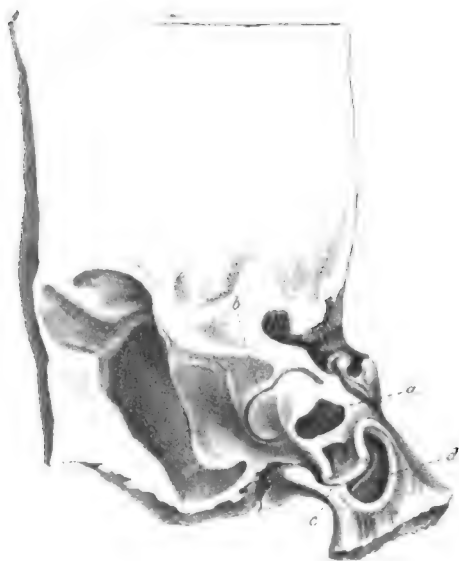
Fig 1

Fig 2

criminately adopted by the ignorant and pretending empiric. It would, in many cases, suggest to the upright and humane practitioner the more eligible plan of attending to the cultivation of the other senses through which the mind of man holds intercourse with the external world; and devoting to the mental improvement and education of the sufferer that time and attention, now too often wasted in the employment of means which only serve to impair the mental and bodily powers, while they impose on the credulity of the patient or his friends.

EXPLANATION OF THE PLATE.

Fig. 1. represents the left temporal bone of Case 1. p. 294. The upper portion of the petrous bone has been removed by a section carried through the irregular cavities representing the vestibule and cochlea, both of which are thus laid open.

a The vestibule.

b The cochlea.

c The commencement of the Fallopian canal, laid open by the section.

Fig. II. represents the right temporal bone from the same subject; shewing the vestibule, vertical semicircular canal, and meatus auditorius internus laid open, together with the malformed cochlea and aquæductus vestibuli.

a The vestibule.

b Vertical semicircular canal.

c Meatus auditorius internus.

d Irregular cavity, representing the cochlea.

e Aquæductus vestibuli, preternaturally large.

Fig. III. represents the left temporal bone of Case 4. p. 298; shewing the vestibule and meatus auditorius internus laid open, together with the malformed semicircular canals and cochlea.

a Vestibule.

b Abnormal continuity between the vertical and obliq   semicircular canals.

c Meatus auditorius internus.

d Irregular cavity representing the cochlea, with a rudimentary lamina spiralis.

x 2

ON

THE EFFECT PRODUCED UPON THE

PULSE

BY CHANGE OF POSTURE.

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INFLUENCE OF SEX, AGE, AND PERIOD OF THE DAY.—EXPERIMENTS
MADE WITH A REVOLVING BOARD.

In the last Number of the Guy's Hospital Reports, I examined the effect produced by change of posture on the pulse of healthy males. I now propose to inquire how far that effect is modified by sex and age.

I wished to collect 100 observations on the pulse of healthy females, that I might compare them with the same number made on the pulse of healthy males; but as, for obvious reasons, opportunities of making correct observations on the pulses of healthy females occur but rarely, I have contented myself with 50 experiments, made under the same conditions, and with the same precautions, as those of which the results have been already detailed.

These 50 experiments gave the following averages:

Age from 18 to 50 inclusive—mean age 27.18.

Standing, 89.26.   Sitting, 81.98.   Lying, 80.24.

Diff. between standing and sitting, 7.28, or $\frac{1}{13.33}$ of frequency standing.

. . . . sitting and lying, 1.74, or $\frac{1}{47.71}$ . . . . sitting.

. . . . standing and lying, 9.02, or $\frac{1}{9.89}$ . . . . standing.

An average of the first twenty-seven experiments, from which all exceptions to general rules are excluded, gives the following numbers:

Mean age, 26.45.

Standing, 91.33.   Sitting, 84.37.   Lying, 79.74.

Diff. between standing and sitting, 6.96, or $\frac{1}{13.13}$ of frequency standing.

. . . . sitting and lying, 4.63, or $\frac{1}{17.33}$ . . . . sitting.

. . . . standing and lying, 11.59, or $\frac{1}{17.55}$ . . . . standing.

On referring to the Table, it will be seen, that in the female, as in the male, the extreme are very remote from the mean results. Thus, if we take the first 27 experiments, we shall find that the difference between standing and sitting may amount to 24, or somewhat less than ¼th of the frequency standing, and fall as low as 1 or $\frac{1}{107}$th of that frequency; between sitting and lying the difference may be as much as 11, or about ⅛th of the frequency sitting, and as little as 1, or $\frac{1}{83}$ of that frequency; and between standing and lying the difference may be as high as 28, or more than ¼th, and as low as 4, or $\frac{1}{13}$d of the frequency in the erect position.

The exceptions to the general rule, though numerous in the male, are still more numerous in the female. The following are the exceptions to the general rule, that a change from the erect to the sitting, from the sitting to the recumbent, and from the erect to the recumbent posture, lessens the frequency of the pulse.

No difference between standing and sitting, 5 in 50, or 10 per cent.
. . . . sitting and lying, 7 in 50, or 14 per cent.
. . . . standing and lying, 3 in 50, or 6 per cent.

Pulse more frequent sitting than standing, 0   0
. . . . lying than sitting, 13 in 50, or 26 per cent.
. . . . lying than standing, 2 in 50, or 4 per cent.

By combining these two classes of exceptions, we have the following:

Pulse not more frequent standing than sitting, 5 in 50, or 10 per cent.
. . . . sitting than lying, 20 in 50, or 40 per cent.
. . . . standing than lying, 5 in 50, or 10 per cent.

Total number of exceptions to general rules, 30 in 50, or 60 per cent.[*]

Total number of experiments in which exceptions to the general rule occur . . . . } 23 in 50, or 46 per cent.

It has already been proved, that the effect produced on the pulse of healthy males by change of posture increases with the frequency of the pulse, and that there is a near approach to regularity in the rate of increase. It would be interesting to compare the pulse of females with that of males in this respect; but as the exceptions to the general rule in females are very numerous, and opportunities of

[*] It must be borne in mind, that the male pulse is here made the standard to which the female pulse is referred: otherwise, the exceptions will be more numerous than the rule.

making careful observations are rare, I have not yet been able to institute an exact comparison. The following, however, are the mean results of 30 observations on pulses ranging from 61 to 120; of which, 10 are from 61 to 80 inclusive; 10 from 81 to 100 inclusive; and 10 from 101 to 120 inclusive.

	61 to 80.			81 to 100.			101 to 120.		
	Standing.	Sitting.	Lying.	Standing.	Sitting.	Lying.	Standing.	Sitting.	Lying.
	71	67	63	92	85	80	108	97	90
Differences ...	4	4	8	7	5	12	11	7	18
Do. expressed fractionally	$\frac{1}{18}$	$\frac{1}{17}$	$\frac{1}{9}$	$\frac{1}{13}$	$\frac{1}{17}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{14}$	$\frac{1}{6}$

It is not improbable, that if a larger number of observations were collected, a greater approach to regularity in the increase would be found to take place. The want of a sufficient number of observations on pulses below 60 and above 120 prevents me from making an exact comparison between the pulse of males and that of females. All, therefore, that can be stated at present, is, that *in females, as in males, the effect produced by change of posture increases with the frequency of the pulse.*

The want of a sufficient number of experiments also prevents me from comparing the pulses of males and females in regard to another point. In males, the exceptions to the general rule are more numerous, as the pulse is less frequent. This does not seem to hold good in females; but further observation is necessary, to ascertain the fact.

The only observations with which I am acquainted, on the effect of change of posture on the pulse of females, are those already quoted from Hohl [*]. They were made on nine pregnant women, and give the following mean results:

Standing, 94.   Sitting, 83.   Lying, 77.
Differences, 11; 6; 17.

The effect of change of posture is here much more considerable than in the experiments contained in the Table. I was, therefore,

[*] Die Geburtshülfliche Exploration von Dr. Anton Friedrich Hohl. *Halle,* 1835.

induced to avail myself of the opportunity afforded me by Dr. Naegele, jun., at the Lying-in Hospital, Heidelberg, of examining the pulses of 14 pregnant women. They give the follow averages:

Mean age, 29.43.

Standing, 87.78.　　Sitting, 83.07.　　Lying, 80.43.

Differences, 4.71; 2.64; 7.35.

These numbers are much less than those of Hohl's experiments, and even less than the mean difference in women not pregnant. The difference between my own experiments and those of Hohl may perhaps be explained by the fact, that Hohl's observations were made on women who were kept for a considerable time in the erect posture during his examination of the fœtal pulse; whilst, in my own experiments, the change from one posture to another was made as soon as the pulse had been counted. It is most probable, that the difference in the effect of change of posture in women who are pregnant, and in those who are not, is not considerable.

Having thus examined the effect produced by change of posture on the pulse of healthy females, I shall proceed to compare the results at which we have just arrived with those obtained from similar experiments upon healthy males. This comparison will discover some differences worthy of remark. These will be best seen by throwing the two sets of experiments into a tabular form.

TABLE I.—*Exceptions included.*

Number of Experiments . . . . Males 100, *Females* 50.

	Age.	Mean Age.	Standing.	Sitting.	Lying.	Difference between Standing and Sitting.	Sitting and Lying.	Standing and Lying.	Same differences expressed fractionally.		
Males,	20—50	27.24	78.90	70.05	66.62	8.85	3.43	12.28	$\frac{1}{8.91}$	$\frac{1}{20.30}$	$\frac{1}{6.42}$
Females,	18—50	27.18	89.26	81.98	80.24	7.28	1.74	9.02	$\frac{1}{12.37}$	$\frac{1}{47.11}$	$\frac{1}{8.89}$
Difference			10.36	11.93	13.62	1.57	1.69	3.26			

TABLE II.—*Exceptions excluded.*

Number of Experiments . . . . *Males* 66, *Females* 27.

	Mean Age.	Standing.	Sitting.	Lying.	Difference between Standing and Sitting.	Sitting and Lying.	Standing and Lying.	Same differences expressed fractionally.		
Males,	26.87	81.03	71.12	65.62	9.91	5.50	15.41	$\frac{1}{8.17}$	$\frac{1}{12.93}$	$\frac{1}{5.13}$
Females,	26.45	91.33	84.37	79.74	6.96	4.63	11.59	$\frac{1}{13.12}$	$\frac{1}{17.76}$	$\frac{1}{7.16}$
Difference . .		10.30	13.25	14.12	2.95	0.87	3.82			

The difference shewn by these Tables between the male and female pulse is too great to admit of explanation by the slight disproportion in age, or even by the unequal number of observations from which the averages are deduced. There can be little doubt that the numbers in the Tables are a near approximation to the true ones, and that they fully justify the following conclusions:

1. *The pulse of the adult female exceeds in frequency the pulse of the adult male of the same mean age, by from* 10 *to* 14 *beats. In the erect posture, it is more frequent by about* $\frac{1}{8}$*th; in the sitting posture, by about* $\frac{1}{6}$ *th; and in the recumbent posture, by more than* $\frac{1}{5}$*th.*

2. *Though the pulse of the adult female is more frequent than the pulse of the adult male, of the same mean age, by* $\frac{1}{8}$*th in the erect, and* $\frac{1}{5}$*th in the recumbent posture; the effect of a change from the erect to the recumbent posture in the male is greater than the effect of the same change in the female, by more than* $\frac{1}{3}$ *d.*

This disproportion in the effect of change of posture on the pulses of the two sexes, considerable as it is, will appear still greater when we take into account the difference in the frequency of the pulse. If the pulse of the males, instead of having, in the erect posture, a frequency of 79 beats, had had a frequency of 89, there would have been a difference between standing and lying of at least 18, instead of 12 beats (see Table III. of former Essay); and the effect of change of posture on the male pulse would have been, to the effect of change of posture on the female pulse, as 18 to 9, or as 2 to 1. Now this difference, great as it may appear, is less than what actually takes place when the effect of change of posture on a given frequency of the pulse in the one sex is compared with that produced on the same frequency

in the other. The correctness of this statement admits of easy proof. From a great number of observations made on the pulses of males and females respectively, I selected those in which the pulse, in the erect position, had the same frequency in each sex. When the same number occurred in either sex more than once, I took an average of all the experiments in which that number occurred; and compared the average so obtained with a single experiment, or with an average of several experiments, as the case might be, in the other sex. 30 such averages gave the following comparative results:—

Total number of experiments :—Males 101, Females 74.

Age of Males from 11 to 50 : mean age, 27.

Age of Females from 7 to 67 : mean age, 25¼.

Pulse ranging from 63 to 102 : mean number, 86.

	Standing.	Sitting.	Lying.
Male ..	86 ..	77 ..	72
Female ..	86 ..	81 ..	80

	Male.	Female.
Difference between standing and sitting,	9	5
. . . . sitting and lying,	5	1
. . . . standing and lying,	14	6

Thus, then, the difference between standing and sitting in the adult male is to the difference between standing and sitting in the adult female, as 9 to 5.

The difference between sitting and lying in the adult male is to the difference between sitting and lying in the adult female, as 5 to 1.

The difference between standing and lying in the adult male is to the difference between standing and lying in the adult female, as 7 to 3; or more than 2 to 1.

The effect produced upon the pulse of males by change of posture exceeds the effect produced on the pulse of females to a still greater degree in early youth than at adult age. This will appear from a comparison of 15 averages, in which the pulse in the erect posture has the same frequency, in each sex, below the age of 20, with the same number of averages in which the pulse has the same frequency in persons of each sex above that age. This comparison is made in the following Table:

Age of Males under 20, from 11 to 20 : mean age, 16

Age of Females under 20, from 7 to 19 : mean age, 11

Age of Males above 20, from 22 to 40 : mean age, 28

Age of Females above 20, from 20 to 75 : mean age, 40

Pulse from 63 to 102 : mean number, 86.

	UNDER 20.			ABOVE 20.	
	Standing.	Sitting.	Lying.	Sitting.	Lying.
Male ..	86 ..	78	74 ..	76	71
Female..	86 ..	84	84 ..	78	77

		Under 20.	Above 20.
Difference between standing and sitting	Male	.. 8 ..	10
	Female	.. 2 ..	8
. . . . sitting and lying . . .	Male	.. 4 ..	5
	Female	.. 0 ..	1
. . . . standing and lying . .	Male	. 12 ..	15
	Female	.. 2 ..	9

Hence, the proportion which the effect of a change from standing to sitting, and from standing to lying, in males under 20 years of age, bears to the effect of the same changes in females under 20 years, is 4 to 1, and 6 to 1, respectively; whilst in the male, the difference between sitting and lying is 4, in the female 0. The proportion which the effect of a change from standing to sitting, from sitting to lying, and from standing to lying respectively, in males above 20 years of age, bears to the effect of the same changes in females above 20 years of age, is expressed by the numbers, 5 : 4; 5 : 1; and 5 : 3.

We have already seen, that where the age is as nearly as possible the same, and the frequency of the pulse alone differs in the two sexes, that the effect produced by change of posture is much greater in the male than in the female: the facts just advanced, prove that where the frequency of the pulse is the same in the two sexes, and the mean age alone varies, the effect of change of posture is also much greater in the male than in the female. Where again, as in the first average employed, the pulse has the same frequency in each sex, and the mean age differs only by 1½ years, precisely the same result is obtained. In order that the proportionate values just stated might be the real ones, it would be necessary that both the frequency of the pulse and the mean age should be the same in each sex; but these conditions cannot be fulfilled, without collecting a greater number of observations than I have hitherto been able to make. At all events, the following fact is established:

The effect of change of posture on any given frequency of the pulse is much greater in the male than in the female, and the disproportion is more marked in early youth than at adult age.

* Of these 15 averages, there is but one in which the effect of change of posture in females above 20 is greater than the effect of change of posture in males above 20.

If we now compare the exceptions to the general rule in the two sexes, we shall find, in this respect also, differences worthy of notice. The following are the exceptions to the general rule, that the pulse is more frequent standing than sitting, sitting than lying, and standing than lying:

	Male.	Female.
No difference between standing and sitting,	5 per cent.	10 per cent.
. . . . sitting and lying,	19 per cent.	14 per cent.
. . . . standing and lying,	2 per cent.	6 per cent.
Pulse more frequent sitting than standing,	3 per cent.	0 per cent.
. . . . lying than sitting,	11 per cent.	26 per cent.
. . . . lying than standing,	5 per cent.	5 per cent.
Pulse not more frequent standing than sitting,	8 per cent.	10 per cent.
. . . . sitting than lying,	30 per cent.	40 per cent.
. . . . standing than lying,	7 per cent.	11 per cent.
Total number of exceptions	45 per cent.	61 per cent.
Total number of instances in which one or more exceptions took place	34 per cent.	46 per cent.

It appears, then, that although, in two instances, the exceptions are more numerous in the male than in the female, *the total number of exceptions is much greater in the female than in the male.*

In more than one instance, the exceptions are twice as numerous in the female as in the male.

The exceptions to the general rule, that the difference between standing and sitting is greater than the difference between sitting and lying, are as follows:

	Male.	Female.
Difference between standing and sitting equal to the difference between sitting and lying,	3 per cent.	8 per cent.
Difference between standing and sitting less than the difference between sitting & lying,	17 per cent.	16 per cent.

I now proceed to inquire how far the effect produced by change of posture is modified by age. For this purpose, I shall compare the mean result of 25 experiments, made on healthy males between the ages of 11 and 15, with the same number made on healthy males between the ages of 21 and 30.

Age.	Standing.	Sitting.	Lying.	Differences.	Do. expressed fractionally.		
11—15	93	85	81	8.4.12	$\frac{1}{13}$	$\frac{1}{21}$	$\frac{1}{8}$
21—30	82	73	70	9.3.12	$\frac{1}{9}$	$\frac{1}{24}$	$\frac{1}{7}$

Here there is the same numerical difference between standing and lying in both cases; but the proportional effect is greater between the ages of 21 and 30 than between the ages of 11 and 15. Had

the number in the erect position been 93 in the adult, as in the child, the effect produced would have been 18, instead of 12 ; and the effect of change of posture in the former would have been to the effect in the latter, as 3 to 2.

In the case of females, the disproportion is much more remarkable ; as will be seen in the following Table.

Age.	Standing.	Sitting.	Lying.	Differences.	Do. expressed fractionally.		
11—15	96	91	90	5.1.6	$\frac{1}{19}$	$\frac{1}{91}$	$\frac{1}{16}$
21—30	91	83	80	8.3.11	$\frac{1}{11}$	$\frac{1}{27}$	$\frac{1}{8}$

Hence, then, the effect produced by change of posture on the pulse of the adult female is nearly twice as great as the effect produced on the pulse of females between the ages of 11 and 15; and the difference would probably be still more marked, if the pulse in the second case had been 96 instead of 91.

The question of the influence of age, however, can be still more accurately determined, by resorting to the method already adopted in ascertaining the effect of sex.   The following is a comparison of 30 averages of the male pulse, obtained in the manner already described.

Number of Experiments... Under 20 years, 69.   Above 20 years, 73.

Pulse from 60 to 118.   Mean number, 83.

	Standing.	Sitting.	Lying.	Differences.	Do. expressed fractionally.		
Under 20, mean age 15	83	76	73	7.3.10	$\frac{1}{11}$	$\frac{1}{25}$	$\frac{1}{8}$
Above 20, mean age 29	83	73	69	10.4.14	$\frac{1}{8}$	$\frac{1}{18}$	$\frac{1}{6}$

The effect, therefore, of a change from standing to lying, on males above 20 years of age, is to the effect, on males under 20 years of age, as 14 to 10, or as 7 to 5.   In the Table at p. 7, the proportion is 5 to 4.

A comparison of 20 averages of experiments on females gives the following results:

Pulse from 63 to 116 : average 92.

	Standing.	Sitting.	Lying.	Differences.	Do. expressed fractionally.		
Under 20, mean age 11	92	88	88	4.0.4	$\frac{1}{23}$	—	$\frac{1}{23}$
Above 20, mean age 38	92	82	81	10.1.11	$\frac{1}{9}$	$\frac{1}{82}$	$\frac{1}{8}$

Hence, the effect produced by a change from standing to lying, in females above 20 years of age, is, to the effect produced on females below 20, as eleven to 4, or nearly as 3 to 1.   The Table at p. 7 makes the proportion $4\frac{1}{3}$ to 1.   The following proposition combines the results just arrived at:

The effect produced upon the pulse by change of posture is less in early youth than at adult age; and the modifying influence of age is more considerable in the female than in the male.

From all that has been stated, in this and the preceding treatise, it is natural to conclude, that where the effect produced by change of posture is least, the exceptions to the general rule are most numerous. The exceptions, therefore, ought to be more numerous in early youth than at the adult age; and such is found to be the case. In healthy males there are 10 exceptions in 25 between the ages of 11 and 20, and 9 in 25 between the ages of 21 and 30. There are 34 exceptions in 82, or about 1 in every $2\frac{1}{2}$ before 20; and 33 in 97, or about 1 in 3 after 20. Hence, in males, the exceptions before 20 are to the exceptions after 20, as 3 to $2\frac{1}{2}$. In females between the ages of 6 and 15, there are 19 exceptions in 25; between 21 and 30, 10 in 25. There are 61 exceptions in 82, or about 3 in 4 before 20; and 23 exceptions in 48, or 1 in 2 after 20. Hence, in females, the exceptions before 20 are to the exceptions after 20, as 3 to 2.

Thus, then, the exceptions to the general rule are more numerous in early youth than at adult age, in the proportion of 3 to $2\frac{1}{2}$ in the male, and of 3 to 2 in the female.

If it were necessary to confirm, by additional arguments, the observations already made on the cause of the differing frequencies of the pulse in the several postures, we might call to our aid some of the facts just recorded. If the effect produced by change of posture be really due to muscular contraction, we should expect to find that effect proportioned to the degree of development of the muscular system : and this is actually the case. Thus, the effect is greater in males than in females, and in early youth than at adult age. It is not my intention to attribute the remarkable differences observed in the effect of change of posture in the two sexes, and at different ages, to this cause alone : it is sufficient for my present purpose to point out the close agreement of the assigned cause with the facts just established.

There is one other circumstance worthy of remark. It has been already shewn, that the exceptions to the general rule are more numerous as the pulse is less frequent. Now, a diminution in the frequency of the pulse is accompanied by a diminution of the effect produced by change of posture. But this statement, though true of either sex, does not hold good when one sex is compared with the other. Thus the pulse of females is more frequent than that of males, but the effect of change of posture is less in the female than in the male; the pulse, also, is more frequent in early life than at the adult age, but the effect of change of posture is less at the former than at the latter period. Now, one circumstance is common to all these cases; and that is, that the exceptions are numerous, whilst the effect

of change of posture is small. This leads to the following general law:

The exceptions to the general rule are more numerous as the effect produced by change of posture is less.

This general law includes that just quoted; viz. That *the exceptions to the general rule are more numerous as the pulse is less frequent.*

I shall conclude this part of my subject by recapitulating the several facts which have been established.

1. In healthy females of the mean age of 27 years, in a state of rest, the number of the pulse is, standing, 89; sitting, 82; and lying, 80: the difference between standing and sitting being 7 beats; between sitting and lying, 2 beats; and between standing and lying, 9 beats. When all exceptions to the general rule are excluded, the numbers are, standing, 91; sitting, 84; and lying, 80: the difference between standing and sitting being 7 beats; between sitting and lying, 4 beats; and between standing and lying, 11 beats. The same differences, expressed fractionally, are as follow;—inclusive of exceptions, $\frac{1}{12}$, $\frac{1}{41}$, $\frac{1}{10}$;—exclusive of exceptions, $\frac{1}{13}$, $\frac{1}{21}$, $\frac{1}{8}$.

2. In females, as in males, the extreme are very remote from the mean results. Thus the greatest difference between standing and sitting is less than $\frac{1}{4}$th, the least $\frac{1}{107}$th, of the frequency standing; the greatest difference between sitting and lying is $\frac{1}{9}$th, the least $\frac{1}{83}$, of the frequency sitting; whilst between standing and lying the difference may be more than $\frac{1}{4}$th, and as little as $\frac{1}{33}$, of the frequency standing.

3. The exceptions are as follow:—To the general law, that the pulse is less frequent sitting than standing, there is 1 exception in 10 experiments: to the general law, that the pulse is less frequent lying than sitting, there are 2 exceptions in 5 experiments: to the general law, that the pulse is less frequent lying than standing, there is 1 exception in 10 experiments. The total number of instances in which 1 or more exceptions to general rules occur, is 46 per cent, or nearly 1 in every 2.

4. In females, as in males, the effect produced by change of posture increases as the frequency of the pulse increases.

The following propositions relate to the differences between the male and female pulse:

1. The pulse of the adult female exceeds in frequency the pulse of the adult male of the same mean age, by from 10 to 14 beats. In the erect posture it is more frequent by about $\frac{1}{4}$th, in the sitting posture by about $\frac{1}{6}$th, and in the recumbent posture by more than $\frac{1}{5}$th.

2. Though the pulse of the adult female is more frequent than the pulse of the adult male of the same mean age, by ¼th in the erect, and ⅕th in the recumbent posture, the effect of a change from the erect to the recumbent posture in the male is greater than the effect of the same change in the female by more than ½ d.

3. The effect of change of posture on any given frequency of the pulse is much greater in the male than in the female; and the disproportion is more marked in early youth than at the adult age.

4. The exceptions to the general rule are more numerous in the female than in the male, in the proportion of 4 to 3.

The following propositions refer to the influence of age :

1. The effect of change of posture is less in early youth than in the adult; and the modifying influence of age is greater in the female than in the male.

2. The exceptions to the general rule are more numerous in early youth than in the adult.

The following proposition refers to both sexes, and to all ages:—

The exceptions to the general rule are more numerous, as the effect of change of posture is less.

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Influence of the period of the day.—According to Knox[*], the effect of change of posture varies greatly at different times of the day. " During the morning, the mere change of posture from the horizontal to the erect shall increase the pulse by about 15 or 20 beats. At mid-day, this increase shall be 10; and in the evening, 4 or 6." Nick[†] states, that the effect of a change from the horizontal to the sitting posture was frequently from 1 to 3 beats less in the evening than in the morning; and that the difference between standing and lying was uniformly greater in the morning than at noon, and greater at noon than at night. These statements are confirmed by the results of 7 experiments made by Dr. Knox on the pulse of a gentleman in perfect health. In the morning, the difference between standing and lying was nearly 29, in the evening 21 : the effect, therefore, in the morning was to that in the evening as 3 to 2 nearly. A mean of 20 experiments made on my own pulse, at these several periods—

[*] Ed. Med. and Surg. Journal, Vol. XI. p. 166.

[†] Beobachtungen über die Bedingungen unter denen die Häufigkeit des Pulses im gesunden Zustand verändert wird. Von Georg. Heinrich Nick. *Tübingen*, 1826. p. 41.

immediately on getting out of bed, after dressing, and before going to bed—gave the following difference between standing and lying:

<div align="center">10.95   7.70   7.25</div>

In this case, though the effect produced upon the pulse after dressing is little more than that which took place on going to bed, the effect on first rising in the morning is, to the effect on going to bed, as 3 to 2 nearly; the same proportion as that of Dr. Knox's experiment. In drawing conclusions from these data, we must guard against an obvious source of fallacy—the varying frequency of the pulse at different times in the day: thus, in Dr. Knox's experiment, the morning pulse, in the erect posture, was 91.25; the evening pulse, 77.33. In my own experiments, the pulse, in the erect posture, at the several times specified, was 70, 68, and 59 respectively. Now, the effect produced by change of posture increases with the frequency of the pulse; and the increase can be calculated with sufficient accuracy. By a reference to Table III. of my first Essay, it will be seen, that where the difference between standing and lying for a pulse of 81 is 15, the difference between standing and lying for a pulse of 101 is 15 increased by 12, or 27: we may assume, therefore, that for a pulse of 91 the difference will be 15 increased by 6, or 21. Now, in the experiment just cited, the difference between standing and lying for a pulse of 77, was 21; and if we suppose the rate of increase to be that of the Table referred to, the difference between standing and lying, for a pulse of 91, will be at least 29.4 beats, and most probably not less than 33. This calculation makes the effect of change of posture in the evening greater than in the morning, by, at the least, nearly 1 beat. A calculation made from a Table of my own pulse, resembling Table III. of my former Essay, proves, that whilst there is, as nearly as possible, the same comparative difference between standing and lying on first rising in the morning, and on going to bed at night; the difference at the latter period is, to the difference after dressing, as nearly 3 to 2. I have discussed this question at greater length than I should otherwise have done, in order to shew the importance of attending, not merely to the effect produced by change of posture at different times and under different circumstances, but also to the frequency of the pulse itself. But this question, like those already examined, admits of a very easy solution. I have collected 60 experiments; of which 20 were made before twelve o'clock, 20 between twelve and half-past five P.M., and 20 from half-past five up to midnight. The same frequency of pulse is compared in each collection of 20 experiments, and the results are as follow:

Standing.	Before 12.		From 12 to 5½ P.M.		From 5½ to 12 P.M.	
	Sitting.	Lying.	Sitting.	Lying.	Sitting.	Lying.
69.80	62.20	59.65	62.95	61.80	61.40	60.75
Diff. between standing and sitting, & sitting & lying	7·60	2.55	6.85	1.15	8.40	0.65
Difference between standing & lying,	10.15		8		9.05	

Thus, then, the effect of change of posture is greatest in the forenoon and least in the afternoon; the effect in the evening being the mean between the other two; and *the effect produced by change of posture on the same frequency of the pulse in the afternoon, forenoon, and evening respectively, is as the numbers* 8, 9, *and* 10. Though the difference is not so great as it seemed to be before the varying frequency of the pulse at different times of the day was taken into account, it is sufficiently well marked to deserve attention: and if it should be confirmed by a larger number of observations, it will add to our knowledge of a very curious and interesting subject—the diurnal changes which take place in many, and probably in all, the more important functions of the human body.

It will be seen that my experiments confirm the fact first clearly established by Dr. Knox—that the pulse is less frequent in the evening than in the morning. The difference amounts to 11 beats.

Experiments made with a Revolving Board.—In the Fifth Volume of the Dublin Hospital Reports, Dr. Graves has stated the results of experiments made to determine the following points: 1. The effect of a change from the erect to the recumbent posture, when that change was effected without muscular exertion on the part of the subject of the experiment. 2. The effect produced upon the pulse by a change from a horizontal to an inverted position of the body. As some experiments, which I have performed with a view of determining the latter question, are at variance with those of Dr. Graves, I have thought it right to publish them; for though of little value in a practical point of view, they are of considerable interest to the physiologist. My own experiments were made in ignorance of those of Dr. Graves. Had I known them, I should probably have placed implicit confidence in their results, and have reasoned upon them as upon established facts: for though the mode of performing them is not accurately stated, they are attested by more than one competent witness. I know of no way of reconciling the difference which exists between my own experiments and those of Dr. Graves, but by stating, first, the mode

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in which his experiments were performed, and then the conditions under which my own were made. Some precautions, taken in the one case and omitted in the other, will probably suggest an explanation.

The following is Dr. Graves's account of his experiments : — " As the muscular exertion necessary to *keep* the body in the erect posture might be considered as the cause of this greater frequency " —" viz. in the erect, than in the recumbent position "—" it became necessary to contrive means of placing the body in any desired posture, without the necessity of muscular exertion on the part of the subject of the experiment : — *this was effected.*" If I am not mistaken in the meaning of this sentence, Dr. Graves wished not merely to avoid that muscular effort by which the position of the body is *changed*, but that, too, by which any one posture is *maintained.* Now, this latter object is not attainable by any means which can be devised ; and therefore the only thing accomplished by Dr. Graves was the *changing* the position of the body without muscular exertion on the part of the subject of the experiment. After giving the result of this experiment, Dr. Graves goes on to state his opinion, that the pulse would be more retarded in the inverted, than in the horizontal position of the body. This opinion he submitted to the test of experiment ; but leaves us as much in the dark, as to the mode of performing it, as he had already done with regard to the mode of effecting a change from the erect to the horizontal posture. He contents himself, in both instances, with the statement, that the thing which he desired to do was effected ; but in omitting to describe the exact method which he adopted, he neglected one great duty of the experimentalist—that of stating, as well the object to be accomplished, as the means of effecting it. The history of every science of observation or experiment teaches us, that a statement of the conditions under which an experiment is performed is not less essential than that of the results of the experiment itself.

In my own experiments, the posture of the body was changed by the following means. A board about seven feet in length, furnished, near one end, with a support for the feet, fixed at right angles to it, was made to revolve freely ; and was provided with pegs, by which it might be retained in any required position. The subject of the experiment was secured to the board in the following way. A strap, attached to the under side of the foot-board, was passed round the instep : a second strap passed over the prominent part of the chest, and was fastened to the board on each side ; whilst two others were made to cross over the shoulders in the form of a soldier's belt, and were secured at each end to the side of the board. Thus, when the

board was perpendicular, the subject of the experiment stood upon the foot-board, and was supported by his own muscles. In passing from the erect to the recumbent posture, the body obtained more and more support, until, in the horizontal position, it was sustained without any exertion of its own muscles. In passing from the horizontal to the inverted position, the body was supported partly by the straps placed round the instep, but chiefly by those which, passing over each shoulder, crossed upon the chest. The support thus provided for the body seemed complete: no pressure was made upon any important part; the head was quite free, and the respiration unaffected. I was myself the heaviest person submitted to experiment; but I felt the support to be complete.

I shall now contrast the results of Dr. Graves's experiments with those which I made with this apparatus. The experiments consist of two distinct parts; the first being the change from the erect to the horizontal position; the second, from the horizontal to the inverted posture.

With regard to the first part of the experiment, Dr. Graves says, that "the difference between the frequency in the horizontal and erect postures was not less than when muscular exertion was used." I have already hazarded the conjecture, that whatever contrivance Dr. Graves may have used, he did nothing more than *change* the posture of the body, instead of allowing it to be changed by the effort of its own muscles; but, that he did not get rid of the muscular contraction necessary to support the body in the erect posture. I know, indeed, of no way in which this muscular contraction can be got rid of: the task of bearing the weight of the trunk might, it is true, be shifted to the knees or hips; but, still, some muscular contraction would be required, whatever might be the point of support. If I am right in my conjecture, the experiments of Dr. Graves and of myself so far admit of strict comparison, and do not materially differ in their results.

The persons whom I submitted to experiment were conveyed from the erect posture, and supported at angles of 60°, 45°, and 30°, and then placed in the horizontal position. The pulse was carefully counted in each of these postures. Observations were made on twenty-three persons; of whom, some were Englishmen, and others German boys. I was at the time residing at Heidelberg. The mean age of the subjects of the experiment was 16 years. In the erect posture, the average frequency, in round numbers, was 89; when placed at an angle of 60°, 86; at an angle of 45°, 83; at an angle of 30°, 78; and in the horizontal posture, 75. Thus, then, the diffe-

rences between each two consecutive positions were 3, 3, 5, and 3 respectively; and the total difference was 14 beats, being about $\frac{1}{7}$th of the frequency in the erect position. The difference between the results of these experiments, and of those in which the posture of the body was changed by the action of its own muscles, is, as we have already observed, less than one beat. The above correspondence between the two classes of experiments proves, indisputably, that the effect produced upon the pulse by change of posture is not due to the muscular contraction by which the posture is changed; whilst the experiments which were detailed in a former Essay leave little doubt that it must be attributed to the muscular effort by which the body is supported. Throughout the Essay from which the account of Dr. Graves's experiments is taken there is distinct evidence that its author confounded the muscular effort by which the posture of the body is changed, with that by which any one posture is maintained: for in the passage already cited, he says, that, " as the muscular exertion necessary to *keep* the body in the erect posture might be considered as the cause of this greater frequency," viz. in the erect than in the recumbent posture, " it became necessary to contrive means of placing the body in any desired position, without the necessity of muscular exertion on the part of the subject of the experiment. This was effected; and it was found, that when the posture was changed, by means of such a contrivance, the difference between the frequency in the horizontal and erect postures was not less than when *muscular exertion was used.*" That Dr. Graves entirely overlooked that muscular exertion by which the body is *supported*, is evident, from his professed inability even to imagine the cause of the effect produced upon the pulse by change of posture, and from the conclusion at which he arrives, " that posture alone was the cause of the retardation observed in the pulse when the body was placed horizontally."

It is worthy of remark, that, in the experiments just described, as well as in those where the posture of the body is changed by the action of its own muscles, the exceptions to the general rule are numerous. Thus, in the 23 experiments, there were 10 exceptions.

I now pass on to the second part of the experiments; and shall, as before, contrast the observations of Dr. Graves with my own. Dr. Graves says, " I now anticipated, that if the body were placed with the head down and the feet up, a still further retardation of the pulse would be produced: it was indeed but natural to conclude, from the preceding experiments, that posture alone was the cause of the retardation observed in the pulse when the body was placed horizontally;

and, consequently, that this effect would be augmented on still more
depressing the head; and that the maximum of retardation would
occur in the inverted position. I was inclined still more to this
opinion, from considering, that, in the inverted position, the return of
blood from the brain being opposed by the force of gravity, that organ
would necessarily become the seat of sanguineous congestion, to a
degree capable of producing cerebral compression, and consequent
retardation of the pulse." "Here, however, ideas were not found to
accord with experiments, and no farther retardation of the pulse was
thus effected; neither, on the other hand, was it accelerated beyond
the number observed in the horizontal position. This fact I verified
by experiments made in the presence of Dr. Jacob, Dr. Apjohn, and
Mr. Harris." "In the inverted posture, although the frequency of
the pulse is not altered, its strength is diminished, and often very
considerably: it is not unusual, too, for it to become irregular; a fact
that may be explained by the greater weight of the blood pressing
back on the aortic valves, and thus necessarily opposing an unusual
impediment to the egress from the left ventricle." It is much to be
regretted, that no description is here given of the mode of performing
the experiments: the want of such a description robs them of all the
value which they would otherwise have had.

In my own experiments, the body was conveyed, as before, from
the horizontal posture, through angles of 30° and 45°, to the inverted
position, with the head downwards and the feet raised in the air. 21
out of the 23 persons experimented on were placed at an angle of
30°, and the pulse fell on the average 1 beat: 18 out of the 23 were
placed at an angle of 45°, and their pulse fell from 77 to 76$\frac{1}{2}$, or $\frac{1}{2}$
a beat: 12 out of the 23 were placed perpendicularly, with the head
down, and the feet raised, and their pulse fell on the average 1$\frac{1}{2}$
beats, namely from 78$\frac{1}{2}$ to 77: the total difference between the hori-
zontal and inverted posture being 3 beats. Now this difference is so
slight, that it scarcely deserves so long a notice; but when we come
to examine the experiments more closely, we find that the small
amount of difference is due to the great number of exceptions to the
general rule of decrease. Thus, when the body was placed with the
head downwards, at an angle of 30°, there were 8 exceptions in 23,
or more than $\frac{1}{3}$, in which the frequency of the pulse was increased;
when placed at an angle of 45°, there were 5 such exceptions in 18,
and 5 in which the pulse had the same frequency as in the former
posture; and when completely inverted, there were 4 cases of increase
in 12, and 2 in which the pulse had the same frequency as when the
body was inclined at an angle of 45°. Now, we have already seen,

that, even in a transition from the erect to the horizontal position, the exceptions to the general rule were numerous; and we could scarcely expect them to be less so in the several inverted postures, even if the same causes, whatever they may be, were alone in action. But other causes came into play, amongst which, fear was not the least influential. The very novelty of the position was, to more than one of the subjects of the experiments, a source of apprehension; whilst in others, the distress produced was too great not to be accompanied by some anxiety. In my own case, the swelling of the neck, the violent pulsation of the carotid arteries, and the sensation of extreme vascular tension referred to the entrance of the vessels into, and their exit from, the skull (a sensation experienced, more or less, by all the subjects of the experiments), rendered it imprudent to continue the experiment beyond an angle of 45°. In some instances it seemed hazardous to go farther than an angle of 30°; and in 2 cases the experiment was stopped at the horizontal posture. Still, in spite of the feelings of anxiety present in almost every case, there is only one instance in which, in one or other of the inverted postures, a decrease did not take place. If we exclude all exceptions to the general rule, the average decrease, when the body was placed with the head downwards, at an angle of 30°, was 5; at an angle of 45°, 3; and completely inverted, 5 beats. If, in order to ensure still greater accuracy, we take those cases in which, without exception, there was a decrease up to any given position, we shall find, that at an angle of 30°, the decrease was 5; at an angle of 45°, 1; and completely inverted, 7. There were only two instances in which there was a continual decrease, without any exception to the general rule; and these occurred in two brothers who had been long in the habit of standing on their heads. In each of these the difference between the erect and inverted postures was 30 beats; the mean difference between the erect and horizontal postures being 15 beats, and that between the horizontal and inverted also 15 beats. When inclined at an angle of 30°, with the head downwards, the mean decrease was $6\frac{1}{2}$ beats; at an angle of 45°, $1\frac{1}{2}$; and completely inverted, 7 beats. Thus, then, in the only two cases in which the habit of standing on the head had been acquired, there was a regular decrease from the erect to the horizontal, and from the horizontal to the inverted position; in 22 out of 23 cases, there was a decrease in some one or more of the inverted postures; and even when all exceptions to the general rule are included, there is a small decrease for each approach to the completely inverted position.

·I ought to state, that the distress produced in almost every case

obliged me to feel the pulse directly after the posture was changed, instead of waiting till the new sensations thus acquired had subsided; and that in the completely inverted posture I did not deem it prudent either to delay counting the pulse, or to count it during a whole minute. Had it appeared prudent to keep the subjects of the experiments for any length of time in any one posture, I make no doubt that the results would have been more uniform, and the effects more considerable. If we take into account all the circumstances calculated to accelerate the pulse—the apprehensions naturally excited by the novelty of the position, and by the painful sensations in the throat and head, and the contraction of the muscles, which, in spite of the support given to the body, must have increased with each approach to the completely inverted posture—we can entertain no doubt whatever, that *the natural tendency of the inverted position of the body is to diminish the frequency of the pulse.*

Though these experiments have no very obvious practical bearing, they are interesting in a physiological point of view. Their results, too, are more in accordance than those of Dr. Graves's experiments with all that we know of the cerebral circulation; and they seem to form a very natural completion to the subject of the effect of change of posture on the pulse. As a part of that subject, I have bestowed upon it a degree of attention to which its intrinsic importance does not entitle it.[*]

[*] In my experiments, I had the occasional assistance of my friends, Drs. Meyer and Philbrick, and Mr. Lingen of Hereford.

TABLE I.—*shewing the* EFFECT *of* CHANGE OF POSTURE *on* 50 HEALTHY FEMALES *in a* STATE *of* REST.—*Mean age,* 27.

[The mark (*) indicates the several Varieties which occurred.]

No. of Expt.	Age	Standing.	Sitting.	Lying.	Difference between Standing and Sitting	Sitting and Lying	Standing and Lying	No. of Expt.	Age	Standing.	Sitting.	Lying.	Difference between Standing and Sitting	Sitting and Lying	Standing and Lying
i	26	102	78	74	24	4	28	xxvi	28	101	100	94	1	6	7
ii	26	100	78	74	22	4	26	xxvii	19	64	62	59	2	3	5
iii	49	88	76	68	12	8	20	xxviii	21	124	124	116	0	8	8
iv	18	108	94	89	14	5	19	xxix	23	78	78	74	0	4	4
v	37	108	94	92	14	2	16	xxx	48	78	78	77	0	1	1
vi	22	110	100	97	10	3	13	xxxi	36	100	84	84	16	0	16
vii	25	124	114	112	10	2	12	xxxii	21	87	76	76	11	0	11
viii	28	86	78	76	8	2	10	xxxiii	18	86	76	76	10	0	10
ix	38	88	82	78	6	4	10	xxxiv	19	66	60	60	6	0	6
x	18	69	65	63	4	2	6	xxxv	26	60	54	54	6	0	6
xi	21	84	80	78	4	2	6	xxxvi	21	94	90	90	4	0	4
xii	21	68	64	62	4	2	6	xxxvii	27	76	76	76	0	0	0
xiii	40	98	94	92	4	2	6	xxxviii	28	111	78	82	33	4	29
xiv	33	88	84	82	4	2	6	xxxix	45	116	100	102	16	2	14
xv	21	86	83	82	3	1	4	xl	35	94	82	84	12	2	10
xvi	22	100	92	84	8	8	16	xli	50	79	68	70	11	2	9
xvii	28	76	70	64	6	6	12	xlii	23	75	68	71	7	3	4
xviii	22	76	72	68	4	4	8	xliii	33	84	84	88	0	4	4
xix	31	92	90	88	2	2	4	xliv	20	62	56	59	6	3	3
xx	20	98	95	84	3	11	14	xlv	20	83	78	80	5	2	3
xxi	21	102	96	88	6	8	14	xlvi	28	84	80	81	4	1	3
xxii	25	75	69	62	6	7	13	xlvii	29	78	74	76	4	2	2
xxiii	27	92	88	80	4	8	12	xlviii	21	116	99	116	17	17	0
xxiv	20	107	106	96	1	10	11	xlix	29	88	82	88	6	6	0
xxv	28	76	74	67	2	7	9	l	24	78	76	79	2	3	1

TABLE II.

Average Results of the preceding 50 Experiments.

	Age.	Standing.	Sitting.	Lying.	Difference between		
					Standing and Sitting.	Sitting and Lying.	Standing and Lying.
Exceptions included . . .	27	89	82	80	$7=\frac{1}{13}$	$2=\frac{1}{41}$	$9=\frac{1}{19}$
Exceptions excluded . . .	26	91	84	80	$7=\frac{1}{13}$	$4=\frac{1}{41}$	$11=\frac{1}{8}$

TABLE III.—EXPERIMENTS MADE WITH A REVOLVING BOARD.

[The mark (*) indicates an increase of frequency.]

No. of Expt.	Age.	1. Standing.	2. Angle of 75°.	3. Angle of 60°.	4. Angle of 30°.	5. Horizontal.	6. Angle of 30°.	7. Angle of 75°.	8. Inverted.	Differences between							Total.
										1 and 2.	2 and 3.	3 and 4.	4 and 5.	5 and 6.	6 and 7.	7 and 8.	
i	14	92	82	82	77	76	73	72	62	10	0	5	1	3	1	10	30
ii	14	114	105	102	100	100	90	88	84	9	3	2	0	10	2	4	30
iii	13	92	87	87	80	77	78	76	76	5	0	7	3	1*	2	0	16
iv	17	86	86	84	79	77	73	72	76	0	2	5	2	4	1	4*	10
v	15	78	77	74	72	66	63	60	68	1	3	2	6	3	3	8*	10
vi	24	84	83	81	73	73	77	80	80	1	2	8	0	4*	3*	0	4
vii	16	84	81	79	74	67	63	66	70	3	2	5	7	4	3*	4*	14
viii	14	82	84	82	80	74	79	68	69	2*	2	2	6	5*	11	1*	13
ix	17	94	92	87	79	80	82	84	82	2	5	8	1*	2*	2*	2	12
x	16	92	76	84	84	84	94	94	92	16	8*	0	0	10*	0	2	0
xi	15	90	88	89	75	86	89	90	78	2	1*	14	11*	3*	1*	12	12
xii	16	104	94	96	84	90	92	92	87	10	2*	12	6*	2*	0	5	17
xiii	12	112	108	102	102	98	96	96	..	4	6	0	4	2	0	..	16
xiv	13	81	74	76	72	67	78	64	..	7	2*	4	5	11*	14	..	17
xv	11	95	90	90	87	84	80	80	..	5	0	3	3	4	0	..	15
xvi	26	80	86	74	66	66	62	60	..	6*	12	8	0	4	2	..	20
xvii	17	102	96	86	77	60	53	74	..	6	10	9	17	7	24*	..	25
xviii	15	77	82	74	74	65	60	60	..	5*	8	0	9	5	0	..	17
xix	15	112	104	102	100	100	92	..	..	8	2	2	0	8	..	..	20
xx	15	84	78	78	75	74	72	..	..	6	0	3	1	2	..	..	12
xxi	24	69	68	64	58	56	52	..	..	1	4	6	2	4	..	..	17
xxii	17	76	75	70	67	60	..	..	..	1	5	3	7	..	..	..	16
xxiii	17	77	76	70	66	66	..	..	..	1	6	4	0	..	..	..	11

OBSERVATIONS

ON

INTUS-SUSCEPTION,

AS IT OCCURS IN INFANTS.

BY JOHN GORHAM.

———

About three years ago, I was informed that an infant only a few months old was dangerously ill, the prominent symptom being hæmorrhage from the intestines. This, in a patient so young, struck me as a rare occurrence; and, as the cause was unknown, a degree of interest naturally attached itself to the case, and rendered me anxious to investigate the subject more closely. Shortly after this, a preparation, taken from the patient above mentioned, was placed in the Museum of Guy's Hospital; in which extensive intus-susception, and inflammation of certain contiguous portions of the intestines, formed the striking peculiarities. Thus the hæmorrhage seemed to be, in some measure, accounted for.—Not long afterwards, I was requested to visit an infant with the same symptom, viz. hæmorrhage. This patient also died; and examination after death exhibited a displacement of exactly the same portions of intestine, with the inflammatory condition observed in the former case.—On making further inquiries, and procuring cases from different sources, I soon became still more impressed with the opinion, that a connection exists between the symptom spoken of, and the condition of the intestinal canal; and this in a more peculiar and especial manner than many would be inclined to admit, were it not substantiated by facts.

Since this period, I have enlarged my experience in infantile disease: and not trusting to it alone, I have availed myself of that of others who are well known in our profession, and who

kindly interested themselves in sending me cases illustrative
of the disease in question.

These preliminary remarks being made, I proceed to give
the particulars of the case that occurred in my own practice:
and after this, I shall make a few observations on *intus-
susception, as it occurs in the infant;* directing especial atten-
tion to the diagnosis.

Mrs. Valence's infant, at four months and five days' age,
has been healthy since birth; with the exception of having one
day had ten or eleven motions, which were greener than
usual.   The infant has lived almost entirely on breast-milk;
but, three days ago, the mother was induced to give it some
panada, under the supposition that the milk was not nou-
rishing, or in sufficient quantity.   The infant was generally
good, and cried but little : she appeared to be well up to yes-
terday morning, when at eight o'clock she passed a natural
motion, and was in apparent health till two P.M., when she
was sick, and vomited immediately after having taken the
breast.   This symptom has continued ever since.   Between
seven and eight of the same evening, it was first observed that
the evacuations per anum consisted of blood, and nothing else:
three napkins were soiled during the night, and in the morn-
ing I was requested to visit the infant.   The above report,
joined with the appearances observable on inspection of the
napkins, gave me a decided impression that the case was one
of intus-susception.   The vomiting, and the discharge of blood
per anum without the slightest admixture of feculent matter,
were the two prominent symptoms which led me to suspect
the disease; so that even prior to seeing the little sufferer,
my prognosis was unfavourable.

The quantity of blood passed amounted to about three or
four teaspoonsful; the skin over the entire body was pale and
hot; there was no emaciation ; the infant lay quiet for a few
minutes ; and then cried out with an expression of pain in the
countenance.   The pupils were dilated; there was slight cough;
pulse averaged, in the half-hour, 200 in the minute ; the vo-
mited matter consisted of milk, part of which was curdled.
The abdomen felt soft and hot: I could not discover any un-
usual prominence or hardness in any of its regions.   On

introducing my little finger into the rectum, nothing abnormal could be perceived: the canal was clear: whence it appeared, that if an intus-susception existed, it was too high to be explored by this means. On withdrawing the finger, some dark-coloured, thickish blood followed, in quantity about a teaspoonful and a half. The infant had vomited six or eight times within the half-hour. An enema, consisting of starch and olive-oil, was now injected cold, but returned almost as fast as it was given. I repeated it shortly after, and with the same result. A large cataplasm was now directed to be applied to the abdomen; and a quarter of a grain of extract of conium, in a teaspoonful of camphor mixture, was directed to be given every four hours, with a grain of calomel. At nine P.M. the infant was lying on her back, and appeared to be more composed: she was looking about in a disconsolate manner, and since the morning had screamed occasionally. No more blood had been passed; the vomiting had continued; she sucked less frequently, and always vomited immediately after taking the breast. Convulsions came on during the night, and were repeated frequently. At nine the following morning, a severe fit seized her; during which, her sufferings terminated in death.

SECTIO CADAVERIS, *six hours after death.* — There were four intus-susceptions of the small intestines, which were easily reduced; and the peritoneum covering these parts was slightly red. The lower portion of the ileum was of a deep-red colour, and intus-suscepted within the ascending colon; which latter was also swallowed within the transverse arch. The appendix cœci was highly injected; and it and the cœcum were occupying the upper part of the invagination (vide Plate II.) The appearances, as they presented themselves to notice during the dissection of these parts, were as follows :—
The transverse arch of the colon was the outermost and containing intestine: it was very much distended (Plate I. fig. 1. *a a a*); and contained, the ascending colon (Plate I. fig. 2. *f f*), the cœcum and its appendix (Plate II. *e g*), and the ileum for the last half-inch (Plate II. *d d*). The mucous membrane of the inflected ascending colon was beautifully injected, villous, soft, and constricted in many places; that of the invaginated

ileum was intensely red, villous, and extremely irregular. The appendix cœci was of a deep reddish-brown colour, and slightly blue in many places.

The membranes were exposed in the following order:
1. The peritoneal covering of the transverse colon.
2. Its mucous membrane; in apposition to
3. The mucous membrane of the ascending colon.
4. Its peritoneal investment.
5. The peritoneal investment of the cœcum, appendix, and ileum; and,
6. Lastly, The mucous membrane of the same parts.

The stomach was empty, and appeared to be of a healthy colour. The small intestines were generally healthy in appearance, and, for the lower three-fourths, contained a yellowish watery fluid: the upper fourth was empty. All that portion of colon which was below the intus-susception, as well as the containing parts, was of a dark-bluish colour. The mesenteric glands were enlarged, some being of the size of large beans.

Intus-susception is not a very uncommon disease, and is frequently fatal*. It is produced by the passing of one portion of intestine into another†, and dragging along with it a part of the mesentery‡. The portion of gut that is received into the other is in a contracted state, and is sometimes of considerable length. It usually happens, that an upper portion of intestine falls into a lower; but the contrary likewise occurs, though rarely§. Intus-susception may take place in any part of the intestinal canal; but, as is shewn by almost innumerable instances, it happens most frequently in the small intestines∥. A representation of an invagination in the jejunum is given by Dr. Baillie¶. On taking

* Baillie Morb. Anat.
† Hunter.
‡ Dr. Velse Defin. (in Haller Disp.) may thus be shortened and improved:—
"Intus-susceptio medicis dicitur, quum tubi intestinalis pars in proximam partem impulsa, in eâ absconditur" (without alluding to the cause).
§ Baillie Morb. Anat.
∥ Idem, et Monro 356.
¶ Fascic. IV. Plate VI. Fig. 1.

a hasty glance at the subject, one might be easily led to consider that it is matter of indifference whether the duo-denum, jejunum, or ileum be affected: yet post-mortem examinations instruct us, that when the lower portion of the latter gut forms a part of the invagination, the disease is inflammatory—generally dangerous—frequently fatal*. Ap-pearances, after death, then, as well as the symptoms during life, together with circumstances of practical importance, seem to suggest the division of the disease into two kinds: the first, that which is unattended with inflammation: the second, that which is attended with acute inflammation and its conse-quences.

OF INTUS-SUSCEPTION UNATTENDED WITH INFLAMMATION.

This species occurs more frequently in infancy than in manhood; and, in most cases, does not merit the name of a disease, as it does not derange the functions of the ali-mentary canal†. One rare instance is on record, where the displacement existed at birth‡. The included portion of the intestine may, in most cases, be disengaged, there being no unnatural thickening or inflammation. The extent of the intus-susception, or of the quantity of intestine re-ceived within the other, varies from 1 or 2, to 8, 10, or even 20 inches: and with the extent, so does danger become manifest. Generally, in this non-inflammatory kind, the invagination is of no considerable length. We not unfre-quently meet with three or four invaginations at the same time. Sometimes there is a much greater number, and all in the natural direction. In one case, no fewer than forty-seven were found in the same body, without the slightest inflammation§. It is very frequent amongst children‖. In every instance of fatal diarrhœa examined by Dr. Cheyne¶, the intestinal canal abounded with singular contractions, and had, in its course, one or more intus-susceptions.

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* See my Plates 1, 2, 3.
† Monro.
‡ Beireil de Intestinis et Intus-suscipientibus (*Helmet.* 1769).
§ Burns.
‖ Monro Morbid. Anat. 356.   Edin. Med. & Phys. Essays, Vol. II.
¶ Dr. Cheyne, Essay II. on Bowel Complaints, 1802, p. 22.

Fifty cases of fatal diarrhœa occurred to Dr. Burn's brother, in all of which were intus-susceptions[*]. The greatest part of 300 children, who died, either of worms or during dentition, at the Hospital de la Salpétrière, and came under the examination of M. Louis, had two, three, four, or even more volvuli, without inflammation[†]. In opening bodies, particularly of infants, Dr. Baillie observes, that an intus-susception is not unfrequently found[‡]. I have opened several infants myself, who have died of different diseases; and in all but one, a volvulus, or several, existed.

There are no symptoms by which we may infer that this simple non-inflammatory intus-susception exists; yet, from its great frequency in children, I am inclined to believe that they are identical with those of colic: for colic is nothing more than a spasmodic contraction of the muscular fibres of the intestines; and the first stage of the intus-susception, the prelude of the invagination, is spasmodic contraction of the muscular fibres also[§]: and they are both very frequent amongst children[‖]. When, therefore, in infants, violent screaming occurs, without any warning, accompanied with hardness of the abdominal muscles, kicking, and often drawing up of the legs, I should consider that these symptoms were referrible to the two diseases in common; and the treatment should be conducted accordingly. Of the causes of this non-inflammatory kind, I may observe, that an infant becomes more predisposed to the disease from the natural irritability of muscular fibre; and it is more frequent in early life, though less dangerous, on account of the greater laxity of fibre, and slighter degree of stricture and swelling[¶]. Any unnatural irritation may excite a partial contraction, and thus produce an invagination: costiveness[**], too much food, irregularities in diet, acrid purgatives—or those which produce much griping[††], such as senna-tea, made by boiling the

* Burns Midwif. 1811. p. 502.
† Mém. de l'Acad. de Chirurg. 4to. Tom. IV. p. 222.
‡ Baillie Morb. Anat.
§ Vide Plate VIII. in Dr. Cheyne's Essay II. p. 49.
‖ Burns.
¶ Monro Morb. Anat. 357.
** Idem.
†† Monro. Burns.

leaves—and diarrhœa, have each been enumerated, by authors, as exciting causes.

From a collection of facts, it appears that this non-inflammatory intus-susception is not dangerous. We have Monro's authority, that it scarcely merits the name of a disease [*]. M. Louis observes, of the cases that occurred to him, " There were no circumstances leading to the supposition that these affections had been injurious during life ; and these cases seem to prove that intus-susception may be formed and destroyed again, by the mere action of the intestines" [†]. Dr. Baillie also remarks, that the parts appear perfectly free from inflammation, and that the invaginations would probably have been easily disentangled from each other by their natural peristaltic motion [‡]. On the other hand, we find Dr. Burns affirming, that this non-inflammatory species of intus-susception is the most frequent cause of fatal diarrhœa ; not less than fifty cases having occurred to his brother, in the course of his dissections. It seems difficult to understand how the Doctor should have arrived at this conclusion ; when it is considered, that diarrhœa may prove fatal without intus-susception ; and that the latter affection, on the other hand, as proved by well-authenticated facts, is present in a vast number of cases, without being injurious, much less dangerous to life. No one can deny the fact of the existence of intus-susception in the cases opened by Dr. Burn's brother ; but if fifty post-mortems were made of infants dying from any other disease, it is more than probable—in fact, it amounts to a certainty—that nearly all would have one or more intus-susceptions in various parts of the intestines. Dr. Dewees says, " It has been observed by almost all writers, that this form of diarrhœa (speaking of the chronic form) terminates, sometimes very suddenly, by violent vomiting or convulsions." "Now," asks this gentleman, "is it not more than probable, in these cases, that the immediate cause of death may have been the invagination of the intestines [§]?" I would answer from facts.—It has never been proved that infants die of this non-inflammatory intus-susception ; for wherever this has been

[*] Morb. Anat.
[†] Mém. de l'Acad. de Chirurg. 4to. edit. Tom. IV. p 222.   [‡] Morbid Anat.
[§] Dewee's Medical and Physical Treatment of Children, p. 325, note.

found, some other disease, the existence of which was ascertained before death, and the fatal nature of which had been proved by the experience of all medical men, was always present.

If this simple invagination were dangerous, probably eight children, if not more, out of every ten, would be carried off by it; and we are certain that this is not the case. I conclude, from the foregoing facts, that no danger is to be apprehended from this slight non-inflammatory intus-susception.

INFLAMMATORY INTUS-SUSCEPTION.

Before passing immediately to the subject of the inflammatory species, I shall say a few words on the production of an intus-susception, and on the circumstances necessary to constitute such a disease. The different parts which compose it must be considered. It is made up of three folds of intestine :—

1. The *inner*, which passes in the direction of the intus-susception.

2. The *middle*, which is a reflection of the inner, and passes in a direction contrary to the intus-susception : and,

3. The *outer*, which is a reflection of the middle, in the direction of the intus-susception.

This third, or *containing* part, is always in the natural *position*. The first, or *contained* part, is always in the natural *direction*, provided the intus-susception be *progressive*—as Hunter would call it. It is, moreover, necessary to the production of an intus-susception, that there be, either, 1. A contraction of the part to be intus-suscepted; or, 2. A dilatation of that part which is to form the outer fold; or, 3. A natural and sudden inequality of calibre of some portion of the intestinal tube.

The first may be produced from *spasm ;* the second, from *flatus ;* whilst the third is always present in the normal condition, viz. at the termination of the ileum in the cœcum. In this situation it is that intus-susception puts on its dangerous and fatal characters; and produces such a complicated malposition of intestines, as would appear almost incredible, unless substantiated by anatomical observation.

The outward fold is the only one which is active, when the disease has once begun; and by its peristaltic motion

it squeezes down the inverted portion; and thus any length of gut may be drawn in.   With regard to the circumstances necessary to its continuation, a remarkable difference obtains between intus-susception at the ileo-colic valve and that at any other part of the intestinal canal: for, as it has been stated that the outer fold is active, so will it continue to drag within it the *contained* intestine, provided that this latter always remain passive.   And here appears to me to be the cause of that most uncontrollable invagination that occurs when the ileum is pushed into the colon: for it is not necessary that any preternatural contraction should be formed in the ileum ere it can enter the large intestine: in order to this, its normal size is sufficient.   How different, on the other hand, is the case of invagination from spasm!   It is in the nature of spasm to be paroxysmal—to go and come quickly: thus, affording a chance of the reduction of intus-susception, from the relaxation of spasm, and the comparative activity of the inner fold, and this in a direction contrary to that of the invagination.   Intus-susception, then, at the ileo-colic valve, occurs without spasm, without a preternatural contraction of intestine, and, consequently, without a chance of reparation from any subsequent dilatation that might have occurred, had spasm existed.   This brings me more immediately to the subject to which all the foregoing observations have been tending; viz. the inflammatory and dangerous form of intus-susception.   This differs very widely, in fact, almost in every circumstance, from the non-inflammatory kind; not only in respect of its symptoms, but also in the manner of its production, its situation, and danger.   As I would refer to facts upon which to ground an opinion, rather than adhere to any preconceived hypothetical custom, I have inserted some Cases in a subsequent part of this communication.   From the post-mortem examinations, the usual situation of inflammatory intus-susception may be seen, and the symptom or symptoms that were constantly present are noticed.   And although it has been stated that the diagnosis of this disease is very obscure, I yet hope to prove, by an appeal to facts, that it is not so in infants and young children; nevertheless, there will remain much to be done towards elucidating the subject as regards adults.

Hunter, when speaking of the diagnosis, says, "When there are violent affections of the bowels, attended with constipa-

tion, we have reason, from the cases which have been ex-
amined in the dead body, to suppose that this disease may be
the cause of them:"—and, a little further on, " There are so
many other diseases, though, that produce the same sym-
ptoms, that nothing can be ascertained." The term '*violent
affections,*' although coming from Hunter, must be allowed to
be rather vague. It is for us to study the symptoms of a
particular lesion first, and theorize afterwards. *A priori,* we
might be led to imagine that such a particular symptom
must, or not, be present in any particular morbid deve-
lopment; but how often this is fallacious!

I shall now proceed to analyze the cases.—If, before having
considered the subject of inflammatory intus-susception, I
had been interrogated respecting any supposition I might
have formed concerning the previous health in the majority
of infants affected with this disease, I should have answered,
" that probably it would have been delicate—that the infant
would have been irritable, and subject to bowel irritation."
Yet, in all the cases on record, with two exceptions, a parti-
cular statement has been made, that the " health was always
good"—that the little patient had never been subject to
bowel complaint—and the like. (Vide Table.) Again, nothing
can be more natural, than to suppose, that if a considerable
intus-susception has actually taken place, a swelling would
be formed, and that this would feel like a tumor externally:
yet how fallacious again is this symptom! In all the cases
that were examined, some portion or other of the large in-
testine colon formed the containing fold of the intus-suscep-
tion. In all, death happened in less than 120 hours.
Vomiting was almost a constant symptom. It might, in-
deed, have been present in all, though not mentioned
in the history of some of the cases. The pulse did not ap-
pear to afford sufficient grounds for any satisfactory inference.
In Dr. Ash's case, it was below the usual number: in my
own, it exceeded it, being 200 in the minute. Nothing is
said about it in the other cases. (This would be consi-
dered a grand omission, in the report of an adult's dis-
ease.) A tumor could be detected in the abdomen in some
of the cases. As for pain, it is almost useless to talk about
such a symptom in an infant who cannot speak, and, often,

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even in children who can: there were, however, strong indi-
cations that it existed; such as, *violent paroxysmal scream-
ings, drawing up of the legs,* and *elevation of the upper lip,*
&c. &c.—The constant symptom, however, was, the passing
of blood per anum, in various degrees of purity; never in-
deed contaminated with feculent matter, but chiefly with
mucus. I would insist especially on this symptom, because
I believe it to be a very important one in infantile intus-
susception. The blood appears to be recent, and fluid, in
many cases; and in quantity varies considerably. In Mr.
Muriel's case it was excessive, more than a teacupful of
blood having been passed. The disease, in fact, amounted
to hæmorrhage from the intestines, of which the causes were
not known before death; insomuch that the infant was com-
pletely blanched and cold ere the fatal termination occurred.
In my own case, I must say that I was struck with the ap-
pearance of this sort of discharge per anum, in a patient so
young. It was not that of common dysentery; where the in-
testine seems reluctantly to supply its blood, to tinge the
mucus which is generally present in that disease. It came
on suddenly in infants who had previously enjoyed good
health. It had nothing to do with diarrhœa; for this was not,
neither had been, present in any of the cases. Neither had
it occurred during a peritonitis; in which disease, sometimes,
blood is passed. Purpura was not present; for this is rare
in infants so young*; neither could hæmorrhoïds or organic
disease be detected†. In all the fatal cases reported, the
same intestine, viz. colon, had formed the *containing* fold; and
this had grasped the *contained* parts (viz. the lower portion
of the ileum, the vermiform process, the cœcum, and more
or less of the inverted colon), which it urged onwards by
its natural peristaltic motion, as if it were endeavouring
to 'expel them by the anus. This it had almost accom-
plished, in Dr. Lettsom's case‡: in my own, the contained

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* Of 17 patients with purpura hæmorrhagica, seen by Dr. Willan, 2 only
were men: 9 were women, of whom 4 were beyond the age of 50: 3 were
boys; and 3 infants not more than a year old.

† I lately had a case (which is inserted in the Medical Gazette for Feb. 10,
1838) of fungoid degeneration of the right kidney, in an infant of eight
months old. Organic disease, however, in infants is not common.

‡ Phil. Trans. Vol. XXVI. p. 312.

portions had not progressed so far: in Dr. Ash's case, Mr. Blizard's, and Mr. Langstaff's, it had proceeded as low as the sigmoid flexure. Nor has the effort only been made, but the expulsion has actually been accomplished in a most astonishing manner; for the invaginated portion has sometimes sloughed, and been discharged per anum, while the agglutination of the parts has preserved the continuity of the intestinal canal. Thus, in a case related in Duncan's Commentaries, eighteen inches of small intestine were voided per anum *. Three similar instances occur in M. Hevin's Memoir: 23 inches of colon came away in one of them, and 28 of small intestines in another †. Other cases occur in the Physical and Literary Essays‡; in Duncan's Annals§; and in the Medico-Chirurgical Transactions ‖, where Dr. Baillie states that a yard of intestine was voided. In 1823, M. Bush recorded a case ¶, in which from 15 to 18 inches of the ileum were discharged from the anus; and recovery was effected on this principle.

Although the cases that I have recorded all occurred in infants less than a twelvemonth old—having been selected intentionally, in order that the resemblance between the phænomena in infancy and those at an adult age might be rendered manifest, and that the symptoms to guide our diagnosis might spring from a practical idea of the subject—yet no age seems to be exempt from this disease. In adult life, the symptoms are more varying and distracting. Thus, in a case reported, by Mr. Bullin of Fleet Market, of an adult, in which the ileum and cœcum were found invaginated within the colon in a manner precisely similar to that of those mentioned in this Paper, the chief symptoms were, suppression of stools, and violent pains in the abdomen, quite unattended with vomiting. But, although all ages may be attacked, it seems that infancy and childhood are more especially the victims of this affection. Dr. Velse gives six cases, of various ages under five, and one adult **: and as age advances, the fatal nature of the malady does seem to diminish or become perverted, from some almost accidental causes, wonderful in their

* Vol. IX. p. 278.
† Hevin in Mém. de l'Acad. de Chirurg. Vol. IV. 4to.
‡ Vol. II. p. 361.   § Vol. VI. p. 298.   ‖ Vol. II.
¶ Med. and Physic. Journal.   ** Haller Disput. Tom. VII. p. 101.

occurrence; and which would appear almost impossible, if well-authenticated facts did not leave us without a doubt.

The most frequent seat of the invagination appears to be at the termination of the small intestines in the cœcum; the colon generally constituting the *containing* and *middle* fold; while the *innermost* consists of the lower portion of the ileum and the vermiform process of the cœcum, as is represented with tolerable accuracy in the drawing. The disease has occurred in the small intestines entirely; but this is somewhat rare. In the Museum of Guy's Hospital there is a preparation of an intus-susception of small intestine, with a portion of coagulable lymph poured out, which had taken the impression of the intestine*. Ruysch has seen the disease in the jejunum; but he says that very numerous observations, not only by himself†, but by a very great many practical anatomists, have shewn that the ileum is the most frequent seat of this affection. Dr. Velse gives reports of six infants; and in all, this was the precise situation of the affection‡. Many observations shew that intus-susception not unfrequently attacks the human body. Ruysch has stated, that it happens much more frequently than had formerly been believed: " Familiarissimum et multò frequentius quam auditum anteà fuerit." This celebrated anatomist, amongst a great number of post-mortem examinations, found it in four cases in succession; and he says, " Many, indeed, in our cities sink daily from this depraved state of intestines, especially infants §". Of the dangerous nature of the disease there can be no doubt. All the cases formerly died; excepting those of mature years, in whom the powers were sufficient to carry them through the process which took place in order that the intestine might slough and be discharged per anum. I shall shortly have to speak of the treatment; and shall then give three cases where a successful apparent reduction of the gut has been accomplished, and complete recovery has resulted. The predisposing cause of this kind of intus-susception is tolerably evident; viz. the

* No. 1851, by Sir A. Cooper.

† " Ileum verò intestinum creberrimam ejusdem sedem, non paucis Anatomiam Practicam exercentibus, observationes quum plurimæ, et mihi ipsi singula sex infantibus corpora indicârunt." *Haller Disp. Anat.* Vol. VII. p. 102.

‡ Haller, Tom. VII. p. 101.   § Ibid. loco citato.

unequal diameters of the end of the ileum, and the commencement of the large intestine. But if the inflammatory invagination be in any other situation, then it would seem that a continuation of spasm (so long, that too much gut has been drawn in, ever again to be replaced, even should relaxation occur) has taken a considerable share in its production. In attending to the exciting cause, a sudden change in diet seems very probably to have produced the disease in the case I have reported. For three days before, the infant had been fed on panada; the very first spoonful of which might have never passed the ileo-colic valve; and the remainder might have accumulated in the ileum, at its lower end, until suddenly, from a strong peristaltic motion, not only the contents, but the intestine itself, passed into the colon. Any unnatural condition of the mucous membrane of the ileum (a part, of all others, prone to irritation) would produce such an abnormal perversion of peristaltic motion, as to lead to the formation of an invagination.

With what disease, then, can this *inflammatory intus-susception in infants* be confounded? Mr. Langstaff, after having informed us that the symptoms of this affection are common to *inflammation of the intestines, hernia,* and *obstruction of the canal from whatever cause,* adds, " *and a volvulus is the least frequent cause of such symptoms.*"—I must entirely disagree with Mr. Langstaff in this last assertion, as far as it relates to the disease in infantile life.—Is hernia a frequent disease amongst children? Yes, it occurs constantly!—But what kind of hernia is it that is thus so frequent—*strangulated?* The answer is, No!—Mr. Pott mentions, that an infant aged one year died of *strangulated hernia;* but adds, that this seldom occurs. Gooch, in his Chirurgical Works, describes a remarkable scrotal hernia which happened in an infant at ten weeks: the symptoms were the same as those arising from intus-susception; but, in addition, there was a swelling extending from the inguen to the scrotum *. I have never seen a strangulated hernia in an infant; but three cases of inflammatory intus-susception in infants have passed before my notice. In inflammation of the intestines of infants, vomiting does not happen immediately after taking food †; the stools are not bloody at first; and some fæcal eva-

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* Gooch's Chirur. Works, Vol. II. p. 207.   † M. Billard.

cuations are passed. Indisposition exists previously, and marks of irritation of mucous membrane. I have, therefore, come to the following conclusions:—

When an infant under a year old is seized with symptoms of strangulated hernia, the cause will most frequently be *intus-susception.*

When dangerous intus-susception exists, its situation will most frequently be at the termination of the ileum in the cœcum.

Hæmorrhage, with absence of all fæcal evacuations from the intestine of an infant, is rare, unless it have for its cause *intus-susception.*

It was by this symptom I diagnosticated the disease in the Case reported at the commencement of the Paper; and I had no hesitation in delivering a prognosis, which, by preparing the friends for a fatal termination, exonerated me from all blame on its occurrence.

Additional facts have only tended to confirm more and more the opinion I entertain respecting the symptoms of this disease.

The subject has been discussed at the Westminster Medical Society; and it is only necessary to read attentively the Case adduced* by Mr. Clarke, in order to see the striking similarity in almost every particular with that given by myself. Mr. Clarke very properly observes, " He did not think the hæmorrhage had been sufficiently dwelt upon, though it was mentioned by some authors." *In the case which I have reported, it formed one of the most prominent features.*

In the treatment of this disease, *bleeding,* to lessen the inflammation, and quicksilver, to remove the cause, have been recommended. Forcible clysters have been used, as a mechanical means; and some have proposed the employment of a long bougie, or piece of whalebone, to push back the intestine. *Anodyne medicines,* the *strongest purgatives,* the *warm bath, blisters over the tumor* where it has been detected, and *emetics,* have all been tried in their turn, without benefit.

The operation of opening the abdomen, in order to disentangle the intus-suscepted intestine, has also been spoken of. M. Hevin, sanctioned by Mr. Samuel Cooper, condemns the proposal. The former gentleman also remarks: " If the equivocal and uncertain nature of the symptoms of volvulus

* Lancet, Feb. 19, 1838.

were not sufficient to deter us from undertaking an operation which, under the most favourable circumstances, would be extremely difficult and imminently hazardous to the patient, the state of the invaginated parts will entirely banish all thoughts of such an imprudent attempt. The different folds of intestine become agglutinated to each other, so that they can hardly be withdrawn, even after death*;" and it is affirmed by many other authors, that a stricture on the intus-suscepted part causes it to inflame†, and even to mortify‡.

However, a case is recorded§, in which an operation was resorted to by Dr. Wilson, and with success. The subject was a Negro, aged 20. He had laboured, for seventeen days, under bilious colic and stercoracious vomiting. An incision was made along the linea alba, commencing above the umbilicus, and extending to two or three inches below it. The ileum was found involved in the stricture: it was adherent; and the adhesion gave way, after several efforts of considerable force: the strangulated bowel was dark livid. His recovery was rapid, and entire.

I certainly should not be inclined to operate in infants, at all events; for it is more than probable that convulsions would destroy them, even ere the operation was finished.

But of all methods of cure, that which I am now about to notice seems entitled to our most careful and attentive consideration: I allude to the treatment by *inflation*. Three successful cases are to be found reported in the American Journal of Medical Science, treated after this manner. I may remark, that it consists merely in introducing the nozzle of a common bellows into the rectum, and gradually inflating the intestines.

The first case that I shall give extracts from, is that treated by John King, esq. The patient was a female, aged 26. After having uneasy sensations in the stomach, obstinate vomiting succeeded, which consisted, at a subsequent period, of yellow matter. A violent screwing pain was also com-

* Ed. Med. Essays, Vol. VI. Dr. Simpson. — M. Hevin, loco citato. — Malcolm's Phys. and Lit. Essays, Vol. II. 360.—Hunter.

† Hunter. Trans. for Improv. of Med. and Chim. Knowledge, I. 108.

‡ Blizard's Med. Chi. Trans. I. 169.—Langstaff's Ed. Med. and Surg. Journal, No. XI.—Soemmering's Trans. of Dr. Baillie's Work, 490-91, note 103.—Moron.

§ American Journal of Med. Science, 1835, p. 262.

plained of, situate between the sternum and umbilicus: it came
on in paroxysms, and ended in vomiting. Calomel, jalap,
castor-oil, laudanum, the warm-bath, and effervescents, were
all useless; and after five days passed without a dejec-
tion, the common bellows was used; and it is stated, that
" as soon as air entered the rectum the countenance lost its
anxiety, and the patient said she felt quite relieved. In a
minute she passed a stool; and complete recovery resulted *."
—The second case is that reported by Dr. Wood. The patient
was a male, aged 35. The symptoms were, first, dry retch-
ing, and hiccup; afterwards, vomiting of a large quantity of
green bile, mixed with feculent matter: violent pain was
complained of in the umbilical region; the pulse was small,
frequent, and irregular. Superficial examination detected no
peculiarity in the form of the abdomen, till the fourth day,
when an unusual fulness and firmness was first discovered in
the right iliac region; but the hand lying upon the spot, a
paroxysm of pain occurred, and an elongated tumor was felt
to rise, with an erectile motion. Purgatives of croton-oil
combined with laudanum, fomentation, enemata of tobacco
infusion, and copious bleeding, were all of no avail; and on
the fifth day, as a last resource, the bellows was used. After
the first inflation, there was no occurrence of violent pain;
the patient said he felt much easier, and wished to pass a
motion: a large quantity of air, however, came away, and
about a gill of very fetid bloody water. In about five hours
after this, two copious dejections were passed; and complete
recovery ensued†.—The third case is reported by Dr. Jane-
way. The symptoms were, vomiting of a dark, fetid, oily
fluid; hiccup; with severe pain round the navel: no motion
was passed for four days, at the end of which time the bel-
lows was used. Six dejections followed in the course of the
day. The patient recovered‡.

This mode of treatment certainly does appear to me to be
deserving of regard. Water, or enemata, would return; but
the effect is totally different, when air is used: its freedom
from all irritating qualities, its elasticity and expansibility
give it a decided preference over enemata.

The report of the case given at the commencement, com-

* American Journal of Med. Science, XXVI. 542.
† Ibid. XXX. 556.   ‡ Ibid. XXV. 271.

bines, it is imagined, a pretty faithful portrait of the disease under consideration, with the post-mortem appearances. The second case will be found to possess all the essential symptoms; and, in fact, bears such a resemblance to the first, that it would be tedious to offer any detailed account of it. However, I have placed it in a concise form; and the abridged report from my Case-book is as follows:—

CASE II.

This occurred in the practice of — Muriel, esq. of Wellington Street, London Bridge. The infant was three months and a half old, and had always been extremely healthy, never having had even a bowel complaint. Violent vomiting and screaming were amongst the first symptoms: fluid blood now passed per anum; and, during the course of the disease, more than a teacupful escaped. There were frequent convulsions. Enemata were returned, by the side of the pipe. The infant died in seventy-two hours. The ileum, cœcum, and appendix formed the contained portions of intestine, while the containing consisted of the transverse colon. The preparation may be seen in the Museum of Guy's Hospital.

Were I to transcribe the other Cases, it would be found that I was merely recapitulating. It will probably suffice, when I state that the symptom to which I have directed peculiar attention was present in all. The age of each was under the twelvemonth. Some portion of the colon formed the outermost or containing intestine in every case; while the lower part of the ileum, to a greater or less extent, was the most internal or contained gut. — I shall therefore merely refer to the reports contained in the Table.

Mr. Finch, a general practitioner, residing at Greenwich, informs me he has treated cases successfully in the following manner. Injections of warm thin gruel are used; and if any advantage be expected to be derived from them, they must be prevented returning. In order to this, Mr. Finch causes the pipe to assume a conical shape, by binding lint, or some soft material, round it. The piston is then pressed with considerable force; and the return of the intestine is known to have taken place by the want of resistance suddenly communicated to the hand. Mr. Finch has treated two cases successfully in this manner. The disease is fraught with danger, if left to itself; and any hint connected with its treatment appears entitled to attention.

A TABLE, *which gives, in a Concise Form, the Particulars of* NINE

No.	Authority.	Age.	Stomach Symptoms.	Intestinal Symptoms.	Form of Abdomen.	Pulse.	Previous Health.
1.	The Author	4 months	vomiting, first symptom	fluid *blood*	no tumour discovered	200	always healthy
2.	—— Muriel, Esq. Wellington Street, London Bridge	3½ months	violent vomiting and screaming, first symptoms	a large quantity, more than a tea-cupful, of fluid *blood*	......	....	always healthy never had bowel complaint
3.	Dr. Ash, Trans. for Improv. of Medical & Surg. Knowledge, I. 108.	9 months	.....	"mucous slime, covered with little streaks of recent fluid *blood*"	deep-seated hardness felt (or thought to be felt) in left hypo. region	below usual number	"healthy, well-looking, never indisposed from birth"
4.	T. Blizard, Esq. Med. Chir. Trans. I. 169.	5 months	vomiting, first symptom	"at first constipation, then discharge of mucus, afterwards of *blood*"	tumour on left side, size of an egg	....	"always healthy, and free from bowel complaint"
5.	Mr. Langstaff, Edin. Med. & Surg. Journal, No. XI.	3 months	violent vomiting, first symptom	nothing but *blood*	hard tumour on left side	....	healthy
6.	Monro, sen. Morbid Anatomy	4 months	.....	slime, slightly streaked with *blood*	......	....	....
7.	Mr. Clarke, Lamb's-Conduit St. Lancet, 10th Feb. 1838.	11 months 3 weeks	vomiting	"hæmorrhage, most prominent feature"	......	quick, feeble	....
8.	M. S. Baer, M.D. American Journal of Med. Science	16 months	violent vomiting	watery evacuation, tinged with *blood*	large tumour in left iliac region	....	rather indifferent, more or less diarrhœa
9.	Mr. H. Cunningham, Camberwell, Med. Gaz. Sept. 15th 1838.	9 months	vomiting	mucus and *blood*. At times, merely pure *blood*	tumor felt in left iliac region.	full, soft	well, in every respect, since birth, excepting tendency to relaxation

CASES *of* INTUS-SUSCEPTION *occurring in* VERY YOUNG INFANTS.

Duration of Disease.	Symptoms of Pain.	Convulsions.	Enema.	Intestines contained.	Intestines containing.	Treatment.
19 hours	violent screamings, in paroxysms, at first	died in convulsions	returned almost as fast as given	end of ileum, cœcum, appendix, ascending colon	transverse colon	enemata, ext. conii, camphor, calomel.
72 hours	violent screaming	frequent convulsion	returned	ileum, cœcum, appendix cœci	transverse colon	placebo.
'60 hours	....	stretched himself out suddenly in a strong spasm: this the first symptom	....	ileum, mesentery, cœcum, ascending colon	sigmoid flexure of colon, and upper part of rectum	purges, fomentations, balneum, calidum, enemata, emp. lyttæ.
120 hours	....	....	....	ileum, cœcum, appendix cœci, ascending and transverse colon	sigmoid flexure of colon, and upper part of rectum	......
120 hours	griping pain in bowels, and excessive crying	....	....	ileum, cœcum, colon	sigmoid flexure of colon	cathartic medicines, warm fomentations.
68 hours	seemed to be in great pain, and cried incessantly for a considerable time	....	little could be thrown up	ileum end of, ascending and transverse colon	descending colon	strongest purges, enemata.
62 hours	violent screaming	....	brought away *blood* and mucus	ileum last four inches, cœcum, ascending and transverse colon	descending colon	gums lanced, calomel, antimony, rhubarb, enema, warm fomentation.
48 hours	violent screaming	....	Unable to throw them up	ileum portion of, cœcum, ascending, transverse, and descending colon	sigmoid flexure of colon	calomel, sinapisms, anodyne fomentations.
about 40 hours	violent screaming	gradually slept away	returned by the pipe	cœcum, ileum considerable portion of, ascending, transverse, descending, & part of sigmoid flexure of colon	lower part of sigmoid flexure of colon, and rectum	enema, balneum, calidum, hirudines regioni tumoris

PLATE I.

Fig. 1.

a a a Transverse arch of colon, which contains the inflected ascending arch, the cœcum, its appendix, the ileum for the last half inch, and the ileo-colic valve.

b b The remaining portion of colon, passing to terminate in the rectum at *c*.

c The rectum, cut off close to the sigmoid flexure of the colon.

d d The last portion of the ileum, seen entering the colon at *e*, where it begins to be intus-suscepted.

e Highly-injected state of peritoneal covering of the ileum, where it begins to be intus-suscepted.

f The terminal half of the vermiform process of the cœcum, of a deep reddish-brown colour, and slightly blue in many places.

Fig. 2.

a a a Transverse arch of the colon, as in Fig. I.; but slit open longitudinally, to expose its contents.

b Descending colon.

c c The last portion of ileum seen entering the colon, as in Fig. I. at *d*.

d The commencement of the invagination.

e e e The mucous membranes of the transverse, and part of the descending colon.

f f f The mucous membrane of the ascending colon, which is inflected, and thus forms a part of the invagination. It is beautifully injected, villous, soft, and constricted in many places.

g The terminal half of the vermiform process of the cœcum; the first portion being intus-suscepted.

[In Table I. the ileum is placed anterior—in this, posterior—to the colon; so that a view might be procured of the extent of the invagination.]
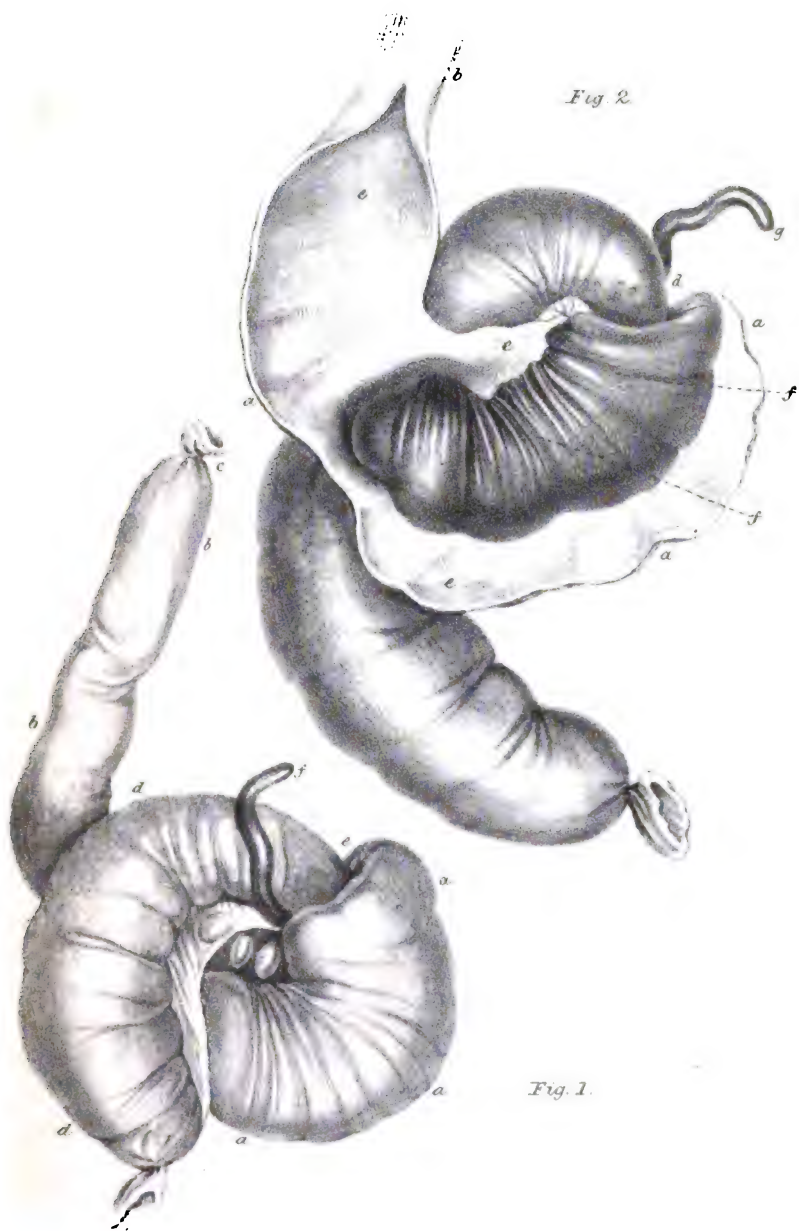
Fig. 2

Fig. 1

PLATE II.

a a a The transverse and descending colon slit open, as in Fig. II.

b b b The ascending and invaginated colon slit open; thus exposing its peritoneal investments, which is now on the interior, and its contents.

c c The peritoneal covering of the inflected ascending colon.

d d The ileum—its peritoneal aspect, seen lying within the inflected colon.

e The appendix cœci—its peritoneal aspect, which also is seen lying within the inflected colon.

f f f The ileum passing behind the colon, as in Fig. II.

g g Parts in the neighbourhood of the ileo-colic valve; which appear spoiled, and rendered useless.

Plate 11.

Fig 3.

CASES AND OBSERVATIONS

IN

MEDICAL JURISPRUDENCE.

BY ALFRED S. TAYLOR.

1. CASE OF POISONING BY OXALIC ACID.

T. J., aged 56, a fellmonger, in needy circumstances, was brought to the hospital, dead, on Monday, April 16th. It appears, that, at ten o'clock in the morning, he swallowed about seven drachms of crystallized oxalic acid; having first mixed it with warm water, and afterwards added to the mixture a glass of rum. At the time he swallowed the poison, no one was present; but, according to his own statement, he immediately afterwards went to his bed, in the room, and lay down. For the first five or six minutes he suffered no pain; but at the end of that time, his son accidentally entered the room, and found him leaning with his head over the side of the bed, vomiting violently. He now complained of severe pain in the region of the stomach; and this was followed by cold clammy perspiration and convulsions. Medical assistance had, in the mean time, been sent for. Warm water was prescribed, and his friends were advised to remove him immediately to the hospital. His son raised him in his arms, to place him in a coach; but before he could reach the door, the deceased died, having made two or three deep-drawn inspirations, at distant intervals, before death. He was brought to the hospital, on the supposition that there might be a chance of resuscitation; but when he arrived, he was quite dead.

The poison was taken about an hour after breakfast, which he ate as usual. There was a little discrepancy in the statements of his relatives, as to the length of time which he survived. By close inquiry, it was found that he must have died in from a quarter of an hour to twenty minutes after having swallowed the poison.

SECTIO CADAVERIS.—The examination was made seventy-two

hours after death. The surface of the body was pale, and entirely free from ecchymosis or lividity. There was slight redness on the inner and upper parts of the thighs, probably from irritation during life. There was not the least trace of putrefaction. The lower extremities were strongly rigid: the upper were also rigid; but this rigidity was easily destroyed, by the application of a slight force. Muscular rigidity, it will be observed, had here lasted longer than usual;— a fact which is, perhaps, to be accounted for, by the extreme coldness of the weather at the time. The countenance was remarkably placid ; the jaw firmly clenched, so as to render it somewhat difficult to examine the mouth ; but, from what was seen of that cavity, the mucous membrane of the tongue and palate appeared pale.

In the chest, the lungs were found connected, by old adhesions, to the sides of that cavity. This was especially the case with the left lung. Both of these organs were of a dark colour; and were much engorged with dark liquid blood, which oozed out in abundance, on cutting into their substance. There was no appearance of disease. The heart was large, and somewhat loaded with fat: the right cavities were collapsed, and empty, containing neither blood nor coagula. In the left there was a small quantity of dark liquid blood. The aorta, externally, was of a red colour, with general ecchymosis and injection of the cellular membrane covering it.

On opening the abdomen, the stomach was seen lying collapsed; and externally, at the larger end, presenting a greenish-yellow colour. Posteriorly and inferiorly it was of a dark brownish-green colour ; and the vessels were seen ramifying through its coats, as if filled with dark consolidated blood. The same appearance was observed at the pyloric extremity, and on the smaller curvature posteriorly. It might have been supposed that these external characters had arisen from putrefaction; but there was no reason to believe this; for the whole of the viscera, internally, were free from any signs of this process; and the weather had been too cold, for some time previously, to allow of its establishment within the short period which had elapsed since the death of the deceased.

Ligatures having been applied, the stomach was removed, and its cavity laid open. It contained about five ounces of a

dark-brown mucous liquid, of a somewhat gelatinous character. This liquid, which was strongly acid, was set apart for analysis.

When the contents were removed, the mucous membrane beneath appeared pale and softened, entirely free from rugæ. There were no traces of inflammation or abrasion in any part; and the surface of the membrane presented, throughout, the same characters. The dark mucous liquid, which lined the organ, appeared as it were continuous with the softened mucous membrane: this was easily detached and raised, but so brittle as to break off under the slightest pressure. The paleness and softening of this membrane were such as we might suppose it to assume after having been for some time boiled in water. In some parts of the stomach, especially towards the lesser curvature, the vessels of the mucous membrane were seen ramifying, and filled with dark-coloured blood which appeared solidified within them. The contrast between the pale membrane and the dark injection of the vessels was so striking, as to bring out the minutest ramifications in strong relief. The appearance resembled, in minuteness and delicacy, the arborescent crystallizations of manganese or iron which are seen on breaking through a nodule of Florentine marble. On raising up the softened membrane, the vessels in the muscular coat beneath presented the same character of arborescent injection. When the stomach was first examined, there was no well-defined boundary between its lining membrane and that of the œsophagus, at the cardiac opening. The same paleness and softening were common to the two. In the course of twenty-four hours' exposure, however, the termination of the œsophageal membrane became better defined.

The thoracic portion of the œsophagus, to the extent of several inches, was tied, and removed. The cellular membrane investing it was reddened and injected. On laying open the cavity, it was observed to contain the same dark brown gelatinous liquid found in the stomach. This liquid was acid; and was evidently part of the contents of the stomach, which had become lodged within the œsophagus by the action of vomiting, during life. On removing it, the lining membrane was seen, of a pale colour, appearing as if

it had been boiled in water or digested in alcohol: it was much drawn up, in small transverse, and in large longitudinal folds. The longitudinal rugæ, extending for several inches, were stiff, hard, and projecting: the transverse folds were regular, and nearly parallel to each other; the interspaces filled with dark-coloured mucus, giving to the surface the appearance seen on graphic granite. The mucous membrane was here and there abraded in long narrow irregular patches; and around these patches numerous minute spots of membrane had been removed, so as to cause it to have a worm-eaten appearance. The membrane was soft, brittle, and easily raised up in small masses by slight pressure, leaving beneath a reddish-coloured ground; upon which blood-vessels were seen running, in arborescent ramifications, like those of the stomach; and containing, like them, dark-coloured blood, which, on examination with a lens, appeared to be firmly consolidated within them.

The intestines were next examined. The duodenum, as well as the jejunum for a considerable part of its length, had, externally, a dark-red colour. On laying open the cavity of the intestines, a ring of inflammatory redness was seen in the duodenum, just beyond the pylorus; and red patches were scattered over other parts of the mucous membrane of the intestine. The jejunum presented a similar appearance; and both of these intestines contained a dark-coloured viscid mucus. This was, however, in much larger quantity in the duodenum than in the jejunum. The ileum and the large intestines were in their natural condition. The liver was of its usual size, somewhat congested with dark-coloured blood; otherwise healthy. The gall-bladder was distended with bile. The spleen and kidneys presented no abnormal appearance; but when cut into, it was seen that they also were congested with dark-coloured blood.

The blood throughout the cavities, except in the minute vessels of the stomach and œsophagus, was universally liquid, and dark-coloured.

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Analysis of the contents of the stomach.—This was performed three days after their removal from the body. The five ounces of dark-coloured liquid had been placed aside, in a

bottle. No subsidence had taken place; but lumps of white mucus were seen scattered through the brown mass. It was of so viscid and gelatinous a character, that it was difficult to pour a small quantity from the bottle, without the whole following it. The colour was of a deep greenish-brown, and the smell highly offensive.

About an ounce of the liquid was boiled, for half an hour, with four times its weight of distilled water. It was then filtered; and a transparent greenish-yellow coloured liquid was obtained, which became more green after having stood a short time. This liquid reddened litmus, strongly, shewing the presence of a free acid. It gave a brownish-white precipitate with infusion of galls, which was most probably due to the presence of gelatin; since boiling and subsequent filtration would have effectually separated any albumen. Besides, nitric acid did not affect this liquid. Permuriate of iron produced no change; but ferrocyanate of potash gave with the acid liquid a claret-red precipitate, precisely resembling that produced by this re-agent in a weak solution of a salt of copper. Potash and ammonia destroyed the green colour, and gave to the liquid a slight pinkish tinge. Hydrosulphuret of ammonia did not produce any effect with the neutralized liquid; but when added to the acid liquid, a dirty-white precipitate (hydrate of sulphur) was, after a time, thrown down. Nitrate of barytes gave a slight milkiness; which, however, entirely disappeared on dilution, shewing that no sulphuric acid was present. A small portion of the liquid was acidulated with a drop of diluted sulphuric acid, and a polished needle suspended in it for forty-eight hours. At the end of this time there was not the slightest change: no copper had become deposited on the needle. That copper was absent, was also rendered probable by the action of ammonia, and the hydrosulphuret of that alkali; although the ferrocyanate of potash is certainly a more delicate test for that metal than ammonia. The effect of ferrocyanate of potash on the filtered liquid, as above mentioned, was remarkable; the precipitate so closely resembling the ferrocyanide of copper in colour, as to render it necessary to shew, by other tests, whether that metal was present or not. Although it is not likely, in the present day, that any practi-

tioner would rely upon the action of a single test as evidence of the presence of a particular poison, yet the effect of ferro-cyanate of potash, in this case, shews how little we can trust to the *colour* of a precipitate, as evidence of its chemical nature, when the solution contains only a small quantity of organic matter. It is probable that some organic principle was here thrown down, perhaps in combination with ferro-cyanic acid; the free acid in the liquid being sufficient to take a part of the base.

Trial tests were now employed, to ascertain whether the free acid present was the oxalic. This being rendered pro-bable, the following process was resorted to, to separate it from the organic matter, and obtain it in such a state that the chemical results might be depended on: for it unfortu-nately happens, that the only two satisfactory tests for this poison—the sulphate of lime and nitrate of silver—are very liable to be affected by the presence of any organic matter.

The acid liquid was cautiously neutralized by pure am-monia; and acetate of lead was then added, until there was no further precipitation. A dense white precipitate speedily fell down, leaving the supernatant liquid of the same greenish colour which it had before. When the pre-cipitate had subsided, it was collected, and well washed on a filter, until it became of a chalky whiteness. As this pre-cipitate was presumed to be oxalate of lead, about ten grains of it were boiled for ten minutes, in a tube, with a small quantity of dilute sulphuric acid. The object of this was, to separate at least a part of the oxalic acid, if present, by the superior affinity which the sulphuric acid has for the oxide of lead. This has appeared to me to be a far more convenient and speedy process than that sometimes recommended, of decomposing the oxalate of lead by passing into water, hold-ing it suspended, sulphuretted hydrogen gas. The small quantity of sulphuric acid which may remain mixed with the oxalic set free on boiling oxalate of lead with the diluted acid, is no objection to the plan here recommended, nor does it form any obstacle to the future steps of the analysis. The only precaution to be observed, is, to employ rather less sul-phuric acid than is necessary for the entire decomposition of the oxalate of lead used.

After boiling, the liquid was diluted with distilled water, and time was allowed for the entire subsidence of the sulphate of lead formed, and any portion of oxalate of lead which remained undecomposed: it was then filtered without disturbing the precipitate, and a very clear highly acid liquid was obtained. The acidity of this liquid could only depend upon the presence of free sulphuric acid, and of the other acid liberated by its action upon the insoluble precipitate of lead; nor, chemically speaking, could it be conceived that any other substance was here present.

The acid liquid was now nearly neutralized by the cautious addition of liquor ammoniæ, containing no carbonic acid; taking care, in this process, not to dilute the liquid too much. The pure alkali answers better than the sesquicarbonate, for neutralization; because a little excess of ammonia will not interfere with the application of the tests, but the slightest excess of the sesquicarbonate will give with them white precipitates, resembling those produced by an oxalate. Under all circumstances, it is better that the liquid should be slightly acid; and thus, if too much alkali have been added in neutralizing, a little nitric acid may be added, to bring about a slight acidity. A trifling quantity of this acid, in a free state, does not prevent the action of the nitrate of silver, although it does that of the sulphate of lime: the latter circumstance, however, is easily remedied by the addition of a few drops of ammonia, after having added the sulphate of lime to the suspected liquid.

Having thus converted the liquid into sulphate, and, as we supposed, oxalate of ammonia, it was divided into two unequal portions. To the smaller portion, *a solution of sulphate of lime* was added; and the liquid being neutral, a fine white precipitate was instantly formed, which was very slow in subsiding. This precipitate could only have been formed at the expense of the foreign acid present; because sulphate of lime is not precipitated either by sulphate of ammonia, which was present in solution, or liquor ammoniæ, which had been added for neutralization. The white precipitate was quite insoluble in tartaric acid; which proved that it could not have arisen from the presence of a tartrate, citrate, carbonate, or phosphate. It was immediately dissolved by a few drops of

nitric acid; by which character oxalate of lime is known from
some other white precipitates. It having been clearly ascer-
tained that no metallic salt was present, the only other bodies
which may be precipitated white by sulphate of lime are the
salts of barytes and strontian. But neither barytes nor
strontian could have been present; because sulphuric acid
was originally used in excess; and if sulphate of strontian be
soluble, it could not remain so in a solution in which there
was oxalate of ammonia; nor could it, under any circum-
stances, yield a precipitate with sulphate of lime. Besides,
the precipitate was entirely dissolved by nitric acid.—Could
it be said that a portion of sulphate of lead was held dis-
solved? This is not possible, since sulphate of lead is not
only not precipitated by sulphate of lime, but it could not
exist as such in the same solution with oxalate of ammonia.

The precipitation by sulphate of lime, and the characters of
the precipitate above described, shew, incontestably, that an
oxalate, and therefore oxalic acid, was present: this could
only have been derived from the contents of the stomach.

Let me here point out two precautions, necessary to be
observed in the application of this test. 1. The solution must
be used in comparatively large quantity, since the sulphate of
lime is so little soluble in water. 2. If too much ammonia
have been added in the neutralizing process, the subsequent
addition of tartaric acid in excess will throw down bitartrate
of ammonia, and materially embarrass the operation.

From the above statement, it might appear superfluous
to have employed any other test for the determination
of the presence of oxalic acid; but, still, it is a maxim in
medico-legal researches, to obtain all the evidence which we
can derive from all possible sources. The second and larger
portion of the liquid having been neutralized by ammonia,
nitrate of silver was added, until there was no further preci-
pitation. A white insoluble powder fell, which was presumed
to be oxalate of silver. This precipitate was entirely soluble
in nitric acid, by which the oxalate is distinguished from the
chloride, cyanide and sulphate of silver: it underwent no
change on boiling it in water, by which the oxalate is emi-
nently distinguished from the tartrate and citrate of silver;
and when collected, carefully dried, and gradually heated on

platina foil, it was entirely dissipated, with a slight detonation.
All these characters clearly proved that the powder was the
oxalate of silver. There was no room to suspect that it
could be any other salt; since the sulphate of ammonia, origi-
nally existing in the liquid, is not precipitated by a solution of
nitrate of silver, unless very concentrated; and then a slight
precipitation may take place after some time. The proper-
ties of the precipitate, however, were not those of the sul-
phate of silver. The nitrate of silver is a very delicate test
for the presence of oxalic acid; which it will detect by a faint
milkiness, when forming only $\frac{1}{3000}$th part of a solution in
water. It is, besides, free from objection, if we take care
that there is no organic matter present, in the solution to
which it is added, and we identify the precipitate by the
chemical characters already mentioned. To obtain enough
of the precipitate for this purpose, we should reserve the
larger portion of the liquid to be analyzed for the application
of this test. A very small quantity of organic matter mixed
with oxalate of silver destroys the property of detonation by
heat. It is only with the pure oxalate that this is observed.

The application of the nitrate of silver in this case confirmed,
in every respect, the results obtained by the previous use of
the sulphate of lime; and although no quantitative analysis
was made, yet it was easy to perceive, from the small por-
tion of the contents experimented on, and the abundance
of the precipitates obtained, that oxalic acid uncombined was
present, in large quantity, in the contents of the stomach. The
copious vomiting during life had not been sufficient to expel it.

One other point remains to be explained. Knowing the
effect of oxalic acid on the red-colouring matter of blood, it
was suspected that the peculiar greenish-brown colour of the
contents of the stomach was due entirely to the action of that
acid on the blood effused by its irritant effect on the mucous
membrane during life. The colouring matter, which was
entirely coagulated by boiling, was left as a dark brown mass
on the filter, in obtaining the liquid for analysis. It was
collected, and boiled in liquor potassæ; in which it was soluble,
without leaving any residue. The solution was of a dark
green by reflected, and of a deep red by transmitted light.
As this is exactly the effect of potash on coagulated hæma-

tosine, it is reasonable to suppose that we had, in the residue left on filtration, principally altered blood.

The contents of the stomach, according to this analysis, therefore, consisted of free oxalic acid, altered blood, gelatin, and mucus. Dr. Christison has shewn that oxalic acid readily dissolves gelatin; and the action of infusion of galls on the boiled and filtered liquid seems to shew that a portion of gelatin was actually dissolved in, and combined with, the acid.

It will be observed, in this, as in most other cases of poisoning by oxalic acid, that there is a very imperfect account of the symptoms which it produces before destroying life. The operation of the poison, in a large dose, is commonly so rapid, that the person dies before medical assistance can be procured. Orfila and Devergie lay it down, that violent burning pain is felt in the stomach *immediately* after the poison has been swallowed. This was certainly not the case here; for pain and vomiting did not supervene until after the lapse of five minutes, and yet the dose was considerable. The vomiting continued as usual until death, but was not adequate to the expulsion of the whole of the poison. There was the same coldness of the skin, with clammy perspiration, which is usually observed in this form of poisoning, indicating a mortal impression on the system; and there were, in addition, convulsive fits, which are not so commonly observed. From the statement of the deceased's son, respiration seems to have been spasmodic immediately before death; for he breathed at long intervals, by deep-drawn sighs. There does not appear to have been any insensibility until just before he died. He took leave of his wife, and seemed to have the perfect possession of his senses.

The period at which death took place was about the average for large doses of oxalic acid, which is the most rapidly fatal of the common irritant poisons. Most of those who have taken an ounce of the acid have died within half an hour; and the greater number within from ten to twenty minutes. Although the deceased had but recently breakfasted, yet the presence of the food in the stomach did not delay the appearance or fatal progress of the symptoms.

The circumstances under which a person who has swal-

lowed oxalic acid dies, are so well marked, and so peculiar, as
to justify, in some instances, from symptoms alone, an infe-
rence as to the nature of the poison, and the cause of death.
Such is the opinion of Dr. Christison; and taking the case as
he represents it, we can scarcely hesitate to give our assent
to his view. He observes, if a person soon after swallowing
a solution of a crystalline substance, having a strongly acid
taste, be attacked with a burning pain in the throat and
stomach, vomiting of bloody matter, imperceptible pulse,
and excessive languor, and die ·in half an hour, or twenty,
fifteen or ten minutes, it is difficult to conceive the existence
of any fallacy which can interfere with the conclusion, that
oxalic acid was the cause of death. There is, certainly, no
disease which puts on the same characters, or destroys life
with[v] the same rapidity. Notwithstanding this, it is very
doubtful whether a Court of Law would act upon an opinion
derived from a description of symptoms only. It would most
probably presume that the crystalline substance admi-
nistered was not oxalic acid; and would require more direct
evidence of its nature, than an inference from the symptoms
produced by it could afford. The difficulty, however, is
more hypothetical than real; since, if the case demanded
legal investigation, (and assuredly if the symptoms were
observed, or reported to any individual, it must fall under
the observation of a coroner's jury,) an inspection would be
ordered, and the real cause of death most probably brought
to light without difficulty. Whether the cause were due to
poison or disease, what could produce death from a state of
health within so short a period, without leaving the most
indubitable traces of its presence or operation on the system?
If the individual has been long dead, and the account of the
peculiar symptoms only comes to light when there can be
no hope of discovering proofs of the operation of the poison
on the body, it appears to me, either that the party charged
with the crime of administering poison would be at once
acquitted; or, if convicted, the conviction would not take
place so much from medical opinion, founded on a description
of the symptoms under which the deceased died, as from
moral and general evidence adduced against the prisoner.
The most that a medical witness could say, would be, that

poisoning was possible, or probable, but not *certain*. The greater number of cases of poisoning by oxalic acid arise from suicide, and therefore present no difficulty to the medical jurist.

The post-mortem appearances, in this case, presented nothing very different from those met with in the few reported instances of death from this poison in the human subject. Engorgement of the lungs, with a collapsed state of the right cavities of the heart, is not, I believe, commonly seen. The quantity of blood present on the left side would have suggested the idea of death from syncope, did not the spasmodic breathing preceding death, and the congestion of the lungs, render it probable that death was here caused by asphyxia. The spinal marrow seems to have been indirectly affected by the action of the poison.

The most striking characters of poisoning by oxalic acid were found in the stomach, although the mucous membrane presented no appearance of abrasion or inflammation in any part. It was uniformly pale, as was also that of the œsophagus; but there were slight traces of inflammation in the duodenum and jejunum. The abrasion of the lining membrane of the œsophagus was most probably due to the violent efforts at vomiting: the continual passage of the contents of the stomach up and down this tube, might, it appears to me, have sufficed to remove portions of the membrane already acted on, and softened, by the acid. Nor is it easy to understand how the stomach should have escaped this abrasion of its lining membrane, except by supposing that the surface was protected from the direct contact of the concentrated acid by the quantity of blood and mucus poured out on its first introduction. The mucous coat had undoubtedly been acted on, and a portion of its gelatin dissolved; but it was merely shrivelled and pale—there was no appearance of loss of substance. The contents of the organ were such as are commonly met with; for oxalic acid has a remarkable effect upon effused blood, although this effect is common to it, with the tartaric, citric, and acetic acids.

The blood had throughout the body a dark colour. How far this might have been due to the introduction of the acid into the circulating system, it is difficult to conjecture: for

although, in these cases, death is caused most probably by sympathy between the mucous membrane of the stomach and a remote organ—as the brain, heart, or spinal marrow—yet this is no objection to the poison being absorbed and conveyed into the circulation. The colour of the contents of the smaller blood-vessels, seen ramifying on the membranes of the stomach and œsophagus, appears to me to have been owing to the direct action of the poison through absorption; for the same appearance was presented by the vessels on the muscular coat, where the mucous lining was stripped off. The only other explanation would be, that the acid acted on the blood contained in them, by imbibition during life, or after death. That oxalic acid does enter into the circulation, is rendered probable by a singular circumstance, noticed in a case referred to by Dr. Christison. Some leeches were applied to the abdomen of a man who lived several hours after having swallowed this poison in a diluted state. Soon after having bitten, the leeches, although healthy, fell off dead; poisoned, as we may presume, by the blood which they had drawn. There is certainly no reason to exclude the idea of oxalic acid entering into the blood; and it would be well, in future cases of poisoning by this substance, for practitioners to notice the state of the blood, and compare its colour with that produced by the direct action of oxalic acid on hæmatosine dissolved in water.

With this knowledge of the action of oxalic acid on the stomach, it must appear surprising that cases should have occurred in which scarcely any post-mortem changes were observed. Dr. Christison mentions the case of a girl who died about thirty minutes after having swallowed an ounce of oxalic acid, in whose body, on inspection, the alimentary canal presented no morbid appearance whatever. I have observed this absence of post-mortem changes, in experimenting on animals. Half a drachm of crystallized oxalic acid, dissolved in a small quantity of water, was given to an animal. There was almost instantaneous vomiting of a frothy matter, which was highly acid; the animal seemed to suffer great pain in the abdomen; but in the course of an hour, it was found in a state of stupor and insensibility, which did not cease until it died, about five hours after the administration

of the poison. On inspection, the surface of the stomach, with the exception of a slight roseate hue towards the pyloric end, presented no unnatural appearance. The organ contained a quantity of mucus, which was faintly acid, but in which oxalic acid could not be detected. The poison appeared to have been effectually discharged by vomiting.

It is easy to understand, that the action of the poison may be much modified, when it is considerably diluted; but this explanation cannot always account for the absence of post-mortem appearances; since, in this experiment, the poison was not much diluted; and in the case referred to by Dr. Christison, there is no mention made of the poison having been taken in a diluted form.

2. SURVIVORSHIP AFTER EXTENSIVE RUPTURE OF THE DIAPHRAGM.

The following case, although not singular, will suggest many important considerations to those interested in the practice of Medical Jurisprudence.

E. L., aged 40, a sailor, was admitted into the hospital, March 7, 1838, under the care of Mr. Morgan. His look was healthy, his body spare; but his general health had been always pretty good. Six months previous to his admission, he had fallen on the deck of a vessel, from a great height; in consequence of which, his ankle was severely injured, and his ribs were fractured. He suffered most from his ankle: a portion of bone had come away, and it had continued bad up to the present time. When examined, it was found to be in a sloughy state; and for this he was admitted. He did not complain of much pain; his appetite was good; and his bowels were regular.

After his admission, the state of his ankle became so much worse, that amputation of the leg was deemed advisable. The operation was performed on the 2d of May, about two months after his admission. In spite of the greatest care bestowed upon his case, he gradually sank; and died on the 4th of June, after having been in the hospital about three months.

Subsequently to the operation, his chest was examined

several times with the stethoscope, and the respiratory mur-
mur was found rather deficient at the apices of both lungs;
but still there was nothing remarkable in the sound of his
voice, nor in the act of respiration before death. The chest,
on percussion, gave out a good sound everywhere, except
over the lower part of the left lung. The deceased stated,
that many years ago he had met with an accident, by which
he had fractured some of his ribs on the left side.

On inspection, the cavity of the cranium presented nothing
particular : there was serous effusion on the pia mater.

When the chest was opened, the heart was observed to be
small, and to be situated rather to the right of the median
line. The most remarkable and unexpected appearances
were seen on the left side of the chest. The left lung, which
was much contracted, lay superiorly, and behind. Its upper
portion was pale, doughy, and crepitant : its middle portion,
unusually divided from the rest, was pale, soft, and com-
pletely hepatized. Inferiorly, this organ was of a dark red
colour, empty, and compressed. The cause of this abnormal
condition now became obvious. Two thirds of this side, or
nearly one half of the whole cavity of the chest, was filled
up by the distended stomach, and a long curve of the arch of
the colon. These parts, which had protruded through an
aperture in the diaphragm, were covered with a great deal
of thin omentum. It was found, on further examination, that
the opening, which was two-and-a-half inches in extent, was
situated in the muscular part of the diaphragm, anteriorly,
and a little to the left of the œsophageal opening. The mar-
gin of the aperture, to which the omentum was in one or two
places strongly adherent, was opake, yellowish, firm, and
even. The cardia was just within the opening, and the
pylorus also posteriorly. The ascending colon ran in on the
right side, and a little posteriorly ; while the descending
colon ran out anteriorly. The bowel, in a contracted state,
to the extent of about twelve inches, was folded vertically, on
the right end of the stomach, which was much distended
with air. This organ contained some dark-coloured liquid :
its surface was reddened, and a good deal softened. It was
covered externally, in great part, by the omentum. The
fifth rib had been fractured near its middle, and the broken

end had pierced the two layers of pleura :—patches of fibrin
were found on the lung.   The omentum adhered to the
broken rib and surrounding parts.   The third rib had been
fractured, and much displaced.   The fourth and sixth ribs
were simply broken, and united.   These injuries were of old
standing.   The viscera of the abdomen presented no particu-
lar appearances.

Ruptures of the diaphragm have in general, according to
M. Devergie, proved speedily fatal : and he looks upon it as
extremely rare that death should not be an *immediate* conse-
quence of this injury.   He refers to a case, however, in
which it was supposed that the individual had survived a
rupture of the diaphragm six months.   There was some am-
biguity about this case, since the man had met with a second
fall, from a height of twenty feet, four days before his death;
and it is not quite clear, from the description, whether the
injury to this organ had been caused six months, or four
days, before death.   In the case here reported, there could be
no doubt of many months having elapsed since the injury.
From the man's statement, he must have survived the only
accident which could have produced the rupture, *at least nine
months*.   The perfect degree of cicatrization, about the aper-
ture, shewed that it must have been of very long standing.
But there is another important circumstance connected with
this case.   We find it stated in some works, that when rup-
ture of the diaphragm is not immediately fatal, the injury
has always been indicated by well-marked symptoms during
life;   and some have even gone so far, as to say, that this
accident might be recognised in the dead body, by a peculiar
state of the countenance.   The symptoms said to have been
observed during life were, nausea, vomiting, greater or less
difficulty of breathing;   flattening of the abdomen;   abnormal
dilatation of the cavity of the chest, contrasting strongly
with the preceding symptom;   risus sardonicus;   and, in all
cases, a perfect impossibility of performing any act requiring
muscular exertion.   These well-marked characters of a mortal
lesion have, it is said, always been present (*Devergie, Méd
Lég.* 11. 198).   The fallacy of looking for such a train of

symptoms, as evidence of the existence of this injury, is well
illustrated by the case before us. Probably the rupture, and
consequent hernia, were about as extensive as we commonly
meet with in these accidents to the diaphragm; but there
were none of these symptoms present: indeed, the discovery
of the injury, with the transposition of the viscera after
death, was entirely unexpected: for although there was
reason to suspect disease of the lungs, yet there was no
ground to suppose that the diaphragm had been lacerated, or
that the stomach and colon were in the cavity of the chest.
At the time of his admission, the man's appetite was good,
and his bodily functions in a healthy condition. Had it not
been for the serious injury to his ankle, it is doubtful whether
he would have presented himself at the hospital, since this
was the chief source of complaint: besides, this alone
appears to have rendered him incapable of exerting himself,
or of performing those actions which it has been pronounced
impossible for persons in his condition to perform.

3. OPEN FORAMEN OVALE.

Among the questions put to a medical witness in a case of
infanticide, we sometimes find the following:—How long has
the deceased child lived after its birth? This question can
seldom be answered with any degree of precision, from
medical facts alone. The changes which take place in the skin,
and umbilical cord, of the living child, after birth, as well as
the changes in the parts peculiar to the fœtal circulation, at
different periods from birth, have been closely examined; and,
from a series of observations, it has been concluded, that the
last-mentioned changes are capable of occasionally furnishing
satisfactory evidence on the point. Among these, Prof. Berut,
of Vienna, has dwelt particularly on the period of closure of the
foramen ovale, in the septum of the auricles. The closure of
this aperture must certainly be admitted as evidence of a child
having lived after birth; but almost daily experience shews
us, that the time at which it closes, is subject to very great
variation: it is doubtful whether we are even in a condition
to fix an average period. Billard's observations, made on
89 cases, have entirely deprived this change of all value, as
a sign for the determination of the survivorship of a child.

Thus, he found the opening entirely closed—once in 18 subjects of one day old—four times in 22 subjects of two days—three times in 22 subjects of three days—twice in 27 subjects of four days. Hence we see that it was found more frequently closed on the second and third days—*i. e.* in $\frac{1}{5}$th and $\frac{1}{7}$th of the cases—than on the first and fourth days—*i. e.* in $\frac{1}{18}$th and $\frac{1}{13}$th of the cases. To make this change of any use, as evidence of survivorship, the cases of its closure ought to increase, in a uniform ratio, in proportion to the period which the child lives after it is born : but here we see, that it was closed twice as frequently on the *second* and *third* days, as on the *fourth.* The examination of a larger number of cases might probably reverse this inference ; but, in the mean time, we learn that we are destitute of all certain data on the subject, and that we have no means of distinguishing the exception from the rule. Probably the difference in the period of closure depends less upon the time which the child survives its birth, than upon the degree of perfection to which, while it lives, the functions of respiration and circulation are carried on. These functions are established in very different degrees, according to whether a child be mature or immature—whether it be strong or weak, healthy or diseased—whether it have been born rapidly or slowly : and thus the circumstances which may influence the closure of the foramen ovale are, in reality, so numerous, as to elude all attempts at generalization for practical purposes.

In young persons and adults at all ages, it is not very uncommon to find the foramen ovale open to a greater or less extent; and in most persons, a communication might be artificially established by the employment of a very slight force. According to Dr. Handyside, the foramen ovale is open in one adult subject out of eight; but probably this statement refers to cases in which the valve has been artificially, although perhaps inadvertently, forced. Among the cases reported in the Inspection-Book, during the present year, there are two, in which this abnormal condition existed.

A woman, aged 50, was admitted February 27, 1838. She died three weeks after her admission, from disease of the uterus. On examining her body, the foramen ovale of the

heart was found open. There does not appear to have been any thing peculiar in her general health, or in the symptoms under which she laboured when admitted, to create a suspicion of the foramen ovale being still pervious.

The second case, which was that of a boy aged 11, fell under the notice of Mr. Key. The boy was observed to be singular in some of his habits, and his intellect was dull : still, his general health appears to have been pretty good. For a few days before his death, he had been unwell, and his lips were observed to have a blueish colour. He died very suddenly, having placed his hand upon his heart, and cried out just before death. On inspection, the heart was found much distended, particularly the right ventricle. The foramen ovale formed a circular opening about half an inch in diameter. There was scarcely a trace of valvular arrangement. The pulmonary artery was small, and the left ventricle less developed than the right.

These cases only confirm what was before well known; namely, that life after birth is not incompatible with this aperture remaining pervious. It is not easy to assign a reason for the occurrence of this abnormal condition in persons who have thus lived many years; but the fact seems to prove, that, in some constitutions, the aëration of a portion only of the blood is sufficient for the support of existence.

SOME OBSERVATIONS

ON

THE CAUSES OF STRANGULATION

IN

HERNIA,

AND ON THE CAUSES OF DEATH:

AND ALSO ON

THE RULES OF TREATMENT WHICH SUCH CONSIDERATIONS ENFORCE.

BY T. WILKINSON KING.

THERE are some opinions on the nature and treatment of strangulated hernia which appear to me not to have received from authors the attention they deserve. Perhaps however, in practice, the opinions of which I speak may sometimes have an influence; that is to say, the experience of a few surgeons may be in advance of that of the authors on the subject in question. This would form the best reason for publishing these observations; and I proceed to unfold them, as briefly as I am able.

Most herniæ exist for years, before they become subject to dangerous strangulation. This, I think, is a fact much more remarkable than it has been hitherto thought: and when we ask, Why does a rupture continue liable to so many accidents, reducible or irreducible, with or without a truss, or with a bad truss, for so long a period, and at such a time of life, and then become obstructed, often without evident cause? we are naturally led to the reply:—Surely some insidious change, some diminution of the sac's mouth, or some peculiar state of the protrusion or of the individual, must be the cause of such serious general alterations.

The following Table contains evidence on which this position is founded. It has been carefully made by Mr. W. H. King. It may be regarded as a just abstract of all the most complete cases which the authorities quoted have furnished; since every case in the books referred to, that did not contain the necessary statements, has not been thought worthy of notice.

TABLE

TABLE OF CASES OF HERNIA,

TO ILLUSTRATE THEIR DURATION AND TERMINATION.

	Authority.	Page.	Sex.	Age.	Kind.	Duration.	Treatment.	Result.
1.	KEY *	15	Female	50	Femoral	Old	Operation	Fatal.
2.	—	16	Male	29	Scrotal	—	—	—
3.	—	17	—	60	Inguinal	44 years	Returned	Fatal: gut found black.
4.	—	18	—	55	—	25 —	Operation	Fatal.
5.	—	19	Female	58	Umbilical	10 —	—	—
6.	—	54	—	45	In groin	4 & more —	—	—
7.	—	70	—	48	In left —	14 —	—	—
8.	—	123	—	32	Inguinal	5 —	—	—
9.	—	129	—	44	In groin	Old	—	Recovered.
10.	—	134	Female	61	Femoral	Reproduced after 2 yrs.	—	—
11.	—	138	—	50	—	Several yrs.	—	—
12.	—	151	—	67	Umbilical	42 —	—	—
13.	—	22	Male	50	Large con-genital.	Omentum adherent	—	Fatal.
14.	SCARPA †	156	Male	50	Inguinal	Old	—	Recovered.
15.	—	157	Woman	..	Femoral	24 years	—	Fatal.
16.	—	161	Male	20	Inguinal	15 —	—	—
17.	—	171	—	60	—	From infancy	—	—
18.	—	190	—	50	Scrotal	From youth	—	Recovered.
19.	—	209	Man	Young	—	Old	—	—
20.	—	214	—	60	—	20 years	—	—
21.	—	223	—	30	Inguinal	Old	Unaided	Cured by slough.
22.	—	231	—	29	Scrotal	15 years	Operation	Recovered.
23.	—	232	—	25	—	8 —	—	—
24.	—	334	—	35	Inguinal	17 —	Unaided	Cured by slough.
25.	—	345	—	25	—	3 —	Operation	Recovered.
26.	—	383	Female	50	Umbilical	14 —	—	Fatal.

* A Memoir on the Advantages and Practicability of Dividing the Stricture in Strangulated Hernia on the Outside of the Sac, by C. A. Key.

† A Treatise on Hernia, by A. Scarpa; translated by J. H. Wishart. "*Edinburgh*, 1814.

Authority.	Page.	Sex.	Age.	Kind.	Duration.	Treatment.	Result.
27. SCARPA ......385..		Female ..	18 ..	Umbilical ..	From birth ..	Operation ..	Recovered
28. —— ....424..		——	.. 14 ..	—— ..	..	—— ..	——
29. —— ....433..		——	.. 56 ..	—— ..	Old ..	—— ..	——
30. LAURENCE *..209..		Male ..	50 ..	Inguinal ..	Many years ..	—— ..	Fatal.
31. —— ....250..		Female ..	60 ..	Umbilical ..	23 — ..	—— ..	——
32. —— ....274..		——	.. 48 ..	Crural ..	Some years ..	—— ..	Recovered.
33. Sir A. COOPER, Part I.† 30..		Male ..	60 ..	Scrotal ..	20 — ..	..	——
34. —— ..:.....46..		Female ..	68 ..	Ventral ..	Old ..	—— ..	Fatal.
35. —— ....53..		Male ..	20 ..	Scrotal ..	From a child ..	—— ..	Recovered.
36. —— ......Part II. 25..		Female..	59 ..	Crural ..	20 years ..	—— ..	——
37. —— ....32..		——	.. 50 ..	—— ..	12 — ..	—— ..	Fatal.
38. —— ....33..		——	.. 45 ..	—— ..	Old ..	—— ..	——
39. —— ....47..		——	.. 64 ..	—— ..	Many years ..	—— ..	Recovered.
40. —— ....51..		——	.. 44 ..	Umbilical :.	Old ..	—— ..	——
41. —— ....55..		——	.. 52 ..	—— ..	Old ..	—— ..	——
42. WILMER ‡.... 44..		Male ..	22 ..	Scrotal ..	Many years ..	—— ..	——
43. HEY § ....166..		——	.. 40 ..	Femoral ..	6 — ..	—— ..	——
44. —— ....174..		——	.. 37 ..	Inguinal ..	Many — ..	—— ..	Fatal.
45. —— ....181..		——	.. 34 ..	Scrotal ..	Some — ..	—— ..	Recovered.
46. —— ....188..		——	.. 61 ..	—— ..	Several — ..	—— ..	Fatal.
47. POTT ‖.......289..		——	.. 30 ..	—— ..	— — ..	—— ..	——
48. —— ....292..		——	.. 40 ..	Inguinal ..	— — ..	—— ..	——
49. —— ....295..		——	.. 36 ..	Scrotal ..	Old ..	—— ..	——
50. —— ....338..		——	.. 54 ..	—— ..	From a child ..	—— ..	——
51. —— ....343..		——	about 40	—— ..	Old ..	—— ..	{ Cured by slough.
52. GUY'S *Clinical Books* ¶ 88..		Female ..	50 ..	Umbilical ..	15 years ..	—— ..	Recovered.
53. —— .... 98..		——	.. 45 ..	Femoral ..	Rt.12. Left 10..	—— ..	Fatal.

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* A Treatise on Ruptures, by W. Laurence, 2d Ed. 1810.

† Anatomy and Surgical Treatment of Abdominal Hernia, in Two Parts. Edit. 1.

‡ Practical Observations on Hernia, by B. Wilmer, of Coventry. *London*, 1788.

§ Practical Observations in Surgery, by W. Hey. 3d Ed. 1814.

‖ The Chirurgical Works of P. Pott, edited by J. Earle, 1790, in 3 Vols. Vol. III.

¶ The MS. Volumes of the Guy's Clinical Report Society—Surgeons' Patients, Female, Vol. I.

Authority.	Page.	Sex.	Age.	Kind.	Duration.	Treatment.	Result.
54. Guy's Clinical Books }	264..	Female ..	45 ..	Umbilical ..	13 years ..	Operation ..	Fatal.
55. —	275 .	..	79 ..	— ..	20 — ..	— ..	Recovered.
56. —	278..	— ..	60 ..	— ..	25 — ..	— ..	Fatal.
57. —	286..	— ..	70 ..	Femoral ..	30 — ..	— ..	Recovered.
58. — *.......	102..	Male ..	67 ..	Inguinal ..	Rt.18. Left 26 ..	Returned ..	{ Enteritis, fatal.
59. —	298..	— ..	41 ..	Scrotal ..	7 years ..	Operation ..	Recovered.
60. —	3..	— ..	67 ..	— ..	12 — ..	— ..	Fatal.
61. Med.Gazette, Vol. I. }	371..	— ..	33 ..	Inguinal ..	From infancy ..	— ..	Recovered.
62. —	704..	Female ..	45 ..	Femoral ..	Several years ..	— ..	—
63. —	449..	— ..	72 ..	Inguinal ..	More than 30 ..	— ..	Fatal.
64. —	67..	Male ..	25 ..	Scrotal ..	From infancy ..	— ..	—
65. —	92..	— ..	22 ..	— .	From childhood..	— ..	Recovered.
66. —	323..	— ..	40 ..	Inguinal ..	Several years ..	— ..	—
67. — Vol. II...	270..	Female ..	40 ..	Femoral ..	5 — ..	— ..	—
68. —	606..	Male ..	68 ..	Scrotal ..	Many — ..	— ..	—
69. —	619..	Female ..	70 ..	Femoral ..	Old ..	— ..	—
70. —	797..	Male ..	60 ..	Rt. groin ..	14 years ..	— ..	—
71. Arnaud †....	356..	— ..	65 ..	Inguinal ..	30 — ..	— ..	—
72. —	371..	— ..	38 ..	Scrotal ..	From 15 to 25 ..	— ..	—
73. —	408..	— ..	18 ..	Inguinal ..	From birth ..	— ..	—
74. MS. Vol. II. .	128..	— ..	53 ..	— ..	25 years ..	Returned ..	
75. — Vol. I....	97..	Female ..	66 ..	Femoral ..	Sudden ..	Operation ..	Fatal.
76. Sir A.Cooper, Part I. }	33..	— ..	60 ..	Crural ..	14 days ..	{ Mortified spontaneously, and healed quite.	
77. — Part II...	15..	— ..	41 ..	— ..	Old ..	Not returned..	Fatal.
78. —	46..	— .	60 ..	Umbilical ..	30 years ..	{ Returned 3d day	{ Relapse & gangrene, fatal.
79. —	46..	— ..	60 ..	— ..	20 — ..	Unaided ..	Fatal.
80. Arnaud	387..	Male ..	50 ..	Inguinal .	Some years ..	{ Returned, sac and all }	Fatal.
81. Med.Gazette, Vol. I. }	484..	— ..	47 ..	Scrotal ..	20 — ..	—	
82. —	647..	— ..	mid...	— ..	20, or many yrs...	Kicked, returned, fatal.	

* The MS. Volumes of the Guy's Clinical Report Society—Surgeons' Patients, Male, Vol. I.

† A Dissertation on Hernias &c. *London*, 1748. Translated.

‡ MS. Volumes of Cases in Guy's Hospital, by Mr. Henry Hales, in my possession.

Authority.	Page.	Sex.	Age.	Kind.	Duration.	Treatment.	Result.
83. Guy's Clinical Books.	345..	Male ..	67 ..	Inguinal ..	30 years ..	Returned	Fatal from another cause.
84. *Med. Gazette,* Vol. I.	705..	—— ..	22 ..	——	.. From boyhood ..	Returned ..	Recovered.
85. ——	484..	—— ..	47 ..	Scrotal	15 years ..	Returned ..	——
86. Key	60..	Female ..	46 ..	Rt. groin ..	7 —— ..	——	——
87. Guy's Clinical Books.	271..	Male ..	53 ..	Scrotal ..	4 —— ..	Returned 10th day	Recovered.
88. Scarpa	300..	—— ..	22 ..	Congenital ..	...	Gangrenous, opened	Quite successful.
89. ——	348..	—— ..	20 ..	——	Not quite recent	Operation (artificial anus)	Fatal, very late.
90. ——	361..	—— ..	26	reproduced by great strain	From infancy ..	—— ..	Fatal.
91. Laurence ...	42..	—— ..	30 ..	Congenital ..	Adherent ..	—— ..	——
92. ——	272..	—— ..	22 ..	Scrotal ..	...	Operation (artificial anus)	Recovery complete.
93. ——	433..	—— ..	24 ..	Congenital ..	12 years ..	Operation ..	Recovered.
94. Wilmer	12..	—— ..	45 ..	——	.. From a child ..	—— ..	——
95. Hey	219..	—— ..	16	Scrotal, following testis	Very recent ..	Returned ..	——
96. —— *..	219..	—— ..	17 ..	Congenital ..	1 year ..	Operation ..	Fatal
97. Pott	308..	—— ..	47 ..	——	.. From infancy ..	Returned ..	Success.
98. ——	321..	—— ..	17 ..	—— ..	—— ..	Operation ..	——
99. *Med. Gazette,* Vol. I.	739..	—— ..	14 ..	——	..	10 years ..	—— ..	——
100. ——Vol. II..	607..	—— ..	42 ..	——	..	Truss many years	Operation (artificial anus)	——

* This is the same case as the preceding, with the interval of 1 year.

We

We have here the abstract of 100 cases of hernia which required surgical aid, on account of urgent symptoms *.

In　2 cases, the duration is not mentioned.

. . 3 or 4 cases we might determine, at once, that acute strangulation was the marked condition.

. . 15 cases, the hernia is said to be " old."

. . 18 cases . . . . of " some, several, or many years'," duration, or to be " adherent in the sac."

. . 46 cases, the duration is defined in years ; and the mean for the whole of these is about 18 years. The minimum, about 4 ; and the maximum, 44 years.

. . 15 cases, the duration may be inferred within a year or two : and the mean for these I make to be 25 years. The maximum near 60.

———
100

* Mr. King has revised the proof of this Table with each case of the authors before him ; and I myself have taken much pains to render it clear and accurate.

The Table itself will be regarded as a Note or Appendix. I have therefore thought it well to arrange as notes most of the deductions which only illustrate my arguments ; though, in themselves, I cannot but consider them as important.

It is a notable circumstance, that all the authors quoted, should furnish no more tolerably complete cases—in all, about 70. No other cases have been excluded from this Table, than such as were too incomplete, or altogether unusual illustrations of hernia. Of course, it would have been easy to have increased the Table greatly, by a free use of the public journals, if it had appeared well to do so.

From the above Table we obtain a tolerable approximation to the ages of commencement, in 58 cases.

First, 2 umbilical occurred at birth, and one inguinal.

Secondly, inguinal herniæ alone are found occurring, at all periods, up to the 24th year, to the amount of 21, or (with the preceding one) 22.

At 25, 1 umbilical occurs.

At 27 and 28, 3 inguinal occur.

At 30 and 32, 2 inguinal, and 2 umbilical.

At 34, 1 inguinal, 3 femoral herniæ (no femoral before this).

From 35 to 40 inclusive, 6 inguinal, 5 femoral, and 5 umbilical.

At 45, 1 inguinal
— 46, 1 femoral
— 48, 1 umbilical
— 49, 1 inguinal
— 55, 1 ——
— 59, 1 umbilical

Thus, up to the 32d year, one hernia commences for each year, and but 5 umbilical to 27 inguinal.

From 34 to 40, *i.e.* in 7 years, there commence

*　*　*　*　*

7 inguinal,
8 femoral,
5 umbilical.
———
20 in all.

After this, again, we find beginning 1 for each year, to above 55.

Hence, of 61 cases, the mean duration is about 20 years; and of 33 cases more, we may say they were indefinitely old: so that 94, out of 98, were in various degrees "old." †

This statement of the duration of herniæ before they become seriously urgent might admit of more abundant proof; but the kind of testimony can, I think, hardly be more distinct or certain.

I may safely confess, that, even allowing the averages I have drawn may, by possibility, be somewhat too high, the Table above has certainly surprised me; notwithstanding I had years ago made use of the argument, when, as is common among the pupils, the anxious topic of a dangerous hernia came under consideration.

I am tempted to suppose that different records might shew a larger proportion of simply acute cases; but the account of these ought not to affect our consideration of the protracted case. The Table, however, indicates the kind of cases liable

† The actual ages of the individuals, when their herniæ demanded surgical assistance, will give some additional light on this point.

From	14 years to 20 inclusive,	10 required aid.
. . .	21	. .	26	. . .	10 . . . .
. . .	27	. .	36	. . .	10 . . .
. . .	37	. .	42	. . .	10 . . . .
. . .	43	. .	56	. . .	30 . . . .
. . .	57	. .	61	. . .	14 . . . .
. . .	62	. .	72	. . .	12 . . . .
At . .	79	. . . .	1

3 undefined.
_____
100

We may say, that 23 cases occurred between 40 and 50, and
. . . . . . 28 . . . . 50 and 60, or
more strictly . . 51 . . . . 40 and 60 inclusive:
yet, still, some inaccuracy depends on the too free use of round numbers, in nearly all the authors: the ages of 40, 45, and 60, for instance, occurring with a rather disproportionate frequency.

15 cases occurred after the 60th year.
78 . . . . the 35th year, including one middle-aged.
21 . . . . before the 35th year . . . . said to be young.
One was middle-aged, and one young: in addition, one had no age named.

to early strangulation; and I do not see any great reason to distrust the proportions of cases which it affords, at least in relation to surgery *.

Occasionally, doubtless, any kind of hernia, suddenly produced—some femoral herniæ more particularly, and a still larger proportion of congenital inguinal herniæ—are liable to immediate or early strangulation, in consequence of the straitness of the stricture; but it can scarcely be thus with long-existing protrusions. Can we suppose, that the neck of the hernial sac grows narrower with increasing years ; or that muscular influence, towards constriction, advances after five and thirty? Certainly not. The hernia increases with time; and the neck enlarges, though more slowly, still in some pretty constant proportion to the size of the protrusion. How does it arise, then, that the danger of strangulation augments as the hernia grows old, and the fatal results of the accident follow the same scale? The answer I propose arises out of the comparison of the case in question with that of a recent hernia; or a small one in a state of acute strangulation, or an inflammatory strangulation, as it has justly been designated.

In the first, the process is comparatively slow, both in the onset and progress, and without healthy tendency; while in the last, however sudden the accession, and violent the action about the constriction, and however severe the inflammation, the results or products are mainly characteristics of natural reparative effort; though under by far the most disadvantageous circumstances, as relate to the narrowness of the stricture, and also the severity of spasm, if such can at any time exist. The increasing liability of herniæ to become

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* Among these cases, we have 39 females to 61 males.

 . . . . the females . . . 21 had femoral hernia.
 . . . . 15 . . umbilical.
 . . . . 2 . . inguinal.
 . . . . 1 . . ventral.
 . . . . . males . . . 2 . . femoral.
 . . . . 13 . . congenital, at the fewest.
 . . . . 46 . . inguinal or scrotal ; and of these, one
or two may have been congenital.

The congenital cases, and the femoral, seem to include the most acute affections.

strangulated as they become old seems, then, to find its explanation in this. With sound health, an incarcerated bowel or epiploon resists alike constriction and turgescence; and one occasionally protruded is for years readily returned, notwithstanding various toils, and perhaps excesses, not unmixed often with great negligence. But with a certain decline of vigour and health, and most commonly with a manifest deterioration of the great depurative organs of the body, the case is altered. The part protrudes once more: and now, whatever part it may be, its own turgescence seems to .strangle it, and all the products of inflammation are of a deleterious or fatal kind: its course is happily slow; but a genuine organizable fibrin, a natural ulcerative absorption, or even fair pus, are sought in vain: a tendency to decomposition is the only uniform character; delayed, however, in proportion to the wideness of the sac's mouth. I have known such a hernia exposed, and returned, without dilating the neck of the sac; and I have seen a surgeon of experience cut down upon and return a red bowel, without any suspicion at the moment; though it was manifest to several around that the fluid of the sac was highly offensive to the smell. The unhealthy aspect of the wound after operations for hernia, if duly considered, cannot but indicate a general condition * inimical to restorative or preservative actions.

There is, doubtless, one other reason why herniæ take some time to become strangulated; and Sir C. Bell adverts very definitely to this, in " The Institutes of Surgery † ":— " When the intestine is protruded into a narrow passage, there is nothing to prevent its being withdrawn on the next peristaltic convolution of the gut. It is when it escapes from the narrowness of the aperture, that it swells up, and cannot be withdrawn. It is this *escape from pressure* which should chiefly attract your attention : it explains every thing." That it explains every thing, however, is too much to affirm ; for it

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* Let me contrast with this a case which I well remember. A young man had a large scrotal hernia ripped open : this was first sewn up with a continued suture, and then reduced by taxis. He died in a few hours, from the severity of other injuries ; but the wound was already firmly united by adhesive matter, without any other effusion.

† Vol. II. page 24.

is manifest that the escape from pressure, and the bulbous dilatation of the protrusion, may recur or persist for years prior to strangulation. We may, once for all, admit that, cæteris paribus, the severity or rather rapidity of the disorder will be in proportion to the narrowness of the stricture ; and we have neither desire nor occasion to reason against the mischievous consequences of various concomitant states and actions, as the distention and irritation in the bowel above the stricture, &c. : but we have now only to maintain and illustrate the circumstances which belong peculiarly to the old hernia in its strangulation; and which may operate in the majority of cases, though in various degrees; but which may, in a rare case (as in an old hernia with a narrow neck, and long, perhaps, very carefully confined by a truss), give place, in appearance rather than in reality, to the state of a simple acute inflammatory stricture.

I shall have to advert to the facts which shew that the heart and arteries, and great glands, become disordered prior to the strangulation in old herniæ: but I am first desirous to expose the nature of the fatal sequel in these cases, as furnishing one of the best indications of the corporeal condition, as well as of the remedial requisitions.

The *causes of death* might, with a good deal of labour, be very well explained, by reference to many combined authorities, but not without much more extensive quotation and partial discussions than I can here enter upon with satisfaction. I propose myself to give a very hasty account, from resources within my own reach; as I seek rather to add to, than repeat, the views that have been advanced.

I have before me unpublished records, more or less complete, of above forty fatal cases of hernia. The majority are connected with my own experience, with regard to the cases themselves, or the inspections, or the specimens removed; and many more have much higher authorities. From all these, the main uniform fact which I would deduce relates to the extent and irreparable nature of the peritoneal inflammation. I avail myself of a brief summary of the most clear and complete of these, chiefly to establish this point. In the majority of instances, if the patient did not die of peritonitis, I do not know what could have been the fatal cause.

A TABULAR VIEW OF THIRTY-EIGHT FATAL CASES OF HERNIA, TO ILLUSTRATE
THE CAUSES OF DEATH, &c.

In 1, the hernia was reduced by taxis: death by *peritonitis :* the gut red.

.. 1* .... *peritonitis ?* .. recovering.

.. 1 .... sac and all, the stricture remaining.

.. 1 .... returned by operation ....

.. 3 .... was not returned : no operation : no gangrene : *peritonitis.*

.. 6 .... was returned by taxis, but ruptured : death by *peritonitis.*

.. 12 .... operation : *peritonitis :* the portions variously dark.

.. 4 .... gangrene extensive.

.. 8 .... was exposed : not returned : artificial anus, or the like : death by *peritonitis.*

.. 1 .... was returned : the omentum divided : death by *internal hæmorrhage.*

* This case is detailed that the reader may judge for himself: the record is by Dr. Hodgkin.

" ELIZABETH NICHOLS, a patient of Mr. Morgan's, in Chapel Ward, was admitted, two weeks before her death, in consequence of strangulated hernia. An operation was performed ; and for some time the patient appeared to be doing well. The progress of the wound was quite satisfactory. There was some tenderness of the abdomen ; for which only a few leeches were considered necessary. The wounds produced by their bites shewed some disposition to gangrene. Almost the whole of the right arm was attacked with erysipelatous inflammation, about three days before death. The stomach became very irritable, rejecting almost every thing taken into it The pulse, though sharp and frequent, was weak. The natural disposition of the patient was extremely irritable. The body was examined on the second day after death.

" *Head.*—The vessels of the brain were loaded with blood, but more so on one side than the other.

" The *lungs* were remarkably free from adhesions, and their structure appeared healthy. There was one small old cretaceous cell in the left: a good deal of cadaveric infiltration posteriorly in both.

" The *heart* was very small, but apparently healthy.

" The blood-vessels in different parts of the peritoneal coat of the intestines were minutely injected, but there did not appear to have been any inflammatory effusion.

" A portion of small intestine, of about 2½ inches in length, which had evidently been the strangulated part, was of a dark colour, being rather carbonaceous than livid (Vide Preparation 1825). The texture of this portion did not, however, appear to be greatly deranged ; and, notwithstanding its colour, it was probably quite capable of performing its functions.

" The mucous membrane of the *stomach* was not corrugated, but was of a
dusky

Now, the above view would have seemed to require no comment, if I could have referred to the author, who fully and fairly expressed peritonitis as a great and common cause of death in the cases concerned; or rather, perhaps, if I could have found one who does not more or less directly, though obscurely, impute some specific agency to a gangrenous portion of intestine, to irritation of the stomach, or the want of stools, or to any thing, as I have been tempted to suppose, rather than to that which physicians know to be so terrible —diffuse peritonitis, with inorganizable and decomposing effusions. The simple wound, or the admission of air or the like, may very well have its own influence, and I have no intention to dispute any thing that has been advanced; but, in deference to all, I seek to point out the full influence of the last-named condition, and thus to enforce my first position and remark upon the curative means, which are consistent both with the cause of strangulation and its most dangerous consequences. In my own mind, the healthy kind of peritonitis, whose products become organized, and whose extension is rarely excessive, is scarcely more alarming than pleuritis; and the states of ascites sufficiently shew, that unirritating effusions may take place universally in the cavity; but, on the contrary, all extravasations of extraneous matters into the peritoneum—from the stomach or the bowels, the liver, or the bladder, from disease or injury—too frequently prove to us that the fatal symptoms of hernia are by no means peculiar. The quick little pulse, the clamminess, depression, and anxiety, belong to all states where extraneous fluids are diffused, whether from a gangrenous bowel or a misdirected

dusky brownish colour. There was nothing remarkable in the other parts of the alimentary canal.

" The *liver* was rather flaccid, and contained a good deal of blood. In the gall-bladder there were one or two small irregular black calculi.

" The *spleen* was of moderate size, and soft.

" The *pancreas* was of natural appearance.

" The *kidneys* were soft ;—the cortical part of a very light whitish colour.

" This patient had no œdema at the time of her death ; nor was it ascertained that she had ever been affected with it, or whether her urine had been coagulable by the application of heat.

" There was nothing farther remarkable in the urino-genital system, except the shrivelled state of the ovaries."—(*Guy's Insp. Book, June* 1827.)

enema; but a well-secluded laceration of the bowel, or three feet of gangrenous intestine, when intus-suscepted, and not violently treated, may be comparatively harmless*.

Let us allow that a few cases die of unrelieved stricture; and others, again, of extensive gangrene:—to what can we impute the fatal termination of the mass in the above list? Not to obstruction or gangrene;—but it is certain that an unhealthy and diffused inflammation, with various inconsiderable proportions of organizable matter, existed in all. The examination of such a case, a very few hours after death, is one of the most offensive that the dead-house affords: it even surpasses the simple case of fæcal extravasation. The mode in which this peritonitis destroys I shall not now regard. I have only noticed, in connection with it, some bronchial and pulmonary obstruction and distention of the right side of the heart. Its effects seem analogous to those of a great destructive laceration or burn, or a corrosive poison.

This is the place in which to remark upon the general condition of the body, as we find it when hernia has proved fatal; but I would not rely too much upon such data.

It is manifest, however, that, advancing towards the middle period of life, the arterial system indicates a change which can scarcely be favourable to the case under consideration; and modern statistics shew a similar increase in the heart, not more favourable to reparative effort. It would be tedious to repeat the varieties of visceral derangements which I have found in the cadaveric inspections of hernia; at least, such precision does not seem to me to be here called for: they are not uniform nor peculiar; yet, whether in respect to the liver, or the kidneys, or the contents of the chest, individually or collectively, it would be easy to shew that some permanent and marked deterioration commonly existed, which was calculated alike to bring on the difficulty, and to promote its untoward progress. The patients with hernia come late to the hospital; nor are they mostly of a hopeful description of per-

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* These intus-susceptions mortify, and are voided. Dr. J. Blundell, I think, suggested an exploring operation, in order to search for a suspected intus-susception; which, when found, was to be gently retroverted with the fingers. I need not say how additionally dangerous the gangrenous gut would be, if left at large in the peritoneum.

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sons. The proneness to erysipelas, or visceral inflammations, under most operations, marks them, as well as many more who are the subjects of operations at the like ages, in great cities. Yet all these constitutional dispositions, as they are called, are found, on inspecting the dead, to be connected with very tangible and permanent alterations of the great viscera. These actual disorganizations are not incompatible with seeming health, but are highly obnoxious when reparation is in progress. If one organ is found affected after death, the change is proportionately more considerable : if several are involved, they are mostly less affected. It is to· be remembered, however—though, as after all fatal operations, the changes are less severe and advanced than when the visceral affection alone seems fatal—yet they are so manifest, that the wonder is, rather, that they were not alone destructive, and that much sooner :—at least, this has been my own reflection, on many occasions.

On the subject of *the treatment* of strangulated hernia, I have no favourite plans to advocate; and I do not propose to introduce any details of experience : my intention is, merely to urge, that the facts here reviewed afford more pressing indications than they have generally been admitted to do, either amongst authors or surgeons. I am aware that abundant opinions might be deduced from books to corroborate almost any set of views ; but, having neither the authority nor the judgment to lay down a system, I would seek only, for myself and younger surgeons, so to illustrate rational principles, that the difficulties of deviating from old plans (if there be any need) shall be openly, carefully, and patiently met ; well knowing, that while it is always decorous, and often safe, to adhere to settled rules, it is sometimes worse than idle ; and that although it is easy to err in forming new opinions, yet something is to be gained by the right use of new facts and more complete views. The mind that can well steer between established rules, and the new, which are only ripening, has, I think, a rare but happy constitution : I deem myself worthy only to strive in such a course. There is a practical laziness in confident and unchanging opinions, which is very pernicious in any minds, and excusable in the aged alone.

In the *reduction of herniæ*, I have certainly seen degrees of force successful that I should be very unwilling to use: and if it be near the truth, that about one-fourth of the deaths by hernia follow the simple taxis, it may be allowed that there is less reason to trust in this means so implicitly as we are taught, whether we regard the employment of force or not. Of course, nothing can ever militate against the early and careful use of the taxis: but may we not conclude, that delay, repetition, and violence, in connection with the actual return of hernia by taxis, would appear more reprehensible than is commonly thought?

I find included in the Table of Fatal Cases, eight in which the taxis was the cause of death. One was a reduction " *en bloc*": a ninth was the same thing (but for the operation): and one only, I think, of the six in which the bowel was ruptured, was connected with some previous accidental injury. One case was a merely dark bowel, well returned: a tenth case was similar, but erysipelas complicated the peritonitis: and, if my memory does not betray me, I have also known one or two other cases of fatal taxis, in which the bowel was returned entire, and no distinct gangrene was discoverable after death.

My only comment on the preceding will be an introductory remark on other means of treatment: and this, indeed, I am tempted to regard as including the first and most rigid rule in the management of strangulated hernia; though I prefer to put it forward as an interrogatory.

How far, then, is it well to employ any means which, whether involving delay or not, have a manifest tendency to render the progress more dangerous, and the recovery more difficult? Should we not at once make choice of those plans which are most safe? And, by way of reply, to these I venture, with some hesitation, to declare, that the observation of *fatal* cases, and the study of well-narrated histories of others which are published, strongly impress me with the conviction, that the patient's difficulties have been increased and accelerated by the remedies employed, in a very considerable proportion of such cases. Let the reader, or the observer, ask himself, with the cases before him, if it be not so, especially with reference to tobacco, purgatives, and anti-

mony, and often in the case of calomel, opium, exposure after
the warm-bath, and of unsuccessful * enemata. Judicious
bleeding may, perhaps, be said to be uniformly harmless and
beneficial: and the operation, itself most dreaded, and often
shunned, is allowed to be safe, almost in proportion as it is
early performed; but often, from the first taxis and local
applications, to the last medicines, I have been struck with
the abundant increase of derangements which the treatment
has been calculated to afford—that is, reviewing the case after
the fatal termination; and I appeal to many recorded cases,
as evidence of this.

The danger of delaying to perform the operation might seem
scarcely to admit of any more determined or satisfactory ex-
position; yet the rational account of the danger seems to me
still obscure in books; and it is to this I would mainly im-
pute the fact, that, notwithstanding many distinct and posi-
tive written rules, the time for operating successfully is often
irretrievably lost. Perhaps the partiality for, and depen-
dence on, particular means of reduction in different surgeons
may be another cause for a too frequent fatal delay, even at
the present day. We may still continually hear it said, "It
is much to be regretted the operation was not performed some
time sooner!" How often is this repeated, when a discoloured
bowel has been exposed, and returned, with a fatal issue!
How often, when the reduction by taxis only leaves the
patient to sink (for this is, I believe, not so very uncommon)!
How often, too, when the hardly and tardily successful opera-
tion leaves the surgeon in long suspense, and the patient in
protracted distress or discomfort!

I regard it as one great merit of the operation which Mr.
Key has advocated, that it is likely to lead to early operation:
the division of the stricture external to the peritoneum, if un-
successful, calls at once for the opening of the sac. In Paris,
where the operation has been had recourse to immediately
on the failure of the taxis, the success has been decidedly
good; and, occasionally, the same has been observed in Eng-

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* I have known the fluids, turpentine, &c., of three successive enemata
absorbed, and the solid parts alone voided on the fourth day: and I state this
fact, because I wish to connect it and similar circumstances with our reflections
on the constitutional effects of remedies.

land, but I am not informed of any conclusive records on this point.*

With regard to the use of *purgatives*—the practice is so generally settled, that it would require more confidence to dissent, than is good, perhaps, for any one to possess. While freely admitting, therefore, that I should follow the common rule of purging after the operation, it is just to say, that much distrust and caution would mingle with the practice, together with some hope of success by less disturbing agents. I have not the spirit to dispute on this point fully with the great authorities, nor would I recommend such a proceeding; but let us look a little into the objections, or rather the reasons for caution, which at present will suffice.

The best argument for purgatives has been employed pretty constantly in the words of Hey; but it amounts to no more than this, *that in proportion as the bowels act well, so the patient does well.* No attempt is made, however, to distinguish between the cause and the consequence.

That purgatives obviate inflammation, is very true; but the truth has not its proper force, unless they do this as safely as other remedies. I have not much respect for the idea of simply unloading the bowels when the stricture has obstructed the small intestine, which is the case nineteen times out of twenty, and when but a part of a single meal, with unusual fluid secretions, constitutes the whole accumulation: and I venture to express my surprise that operators and authors do not appear to have had a thought of their remedies turning the scale

* The observations which may be deduced from our first Table, in favour of the operation, are not quite unexceptionable; but such as they are, they deserve some notice.

Of the 100 cases, 80 or ⅘ were submitted to the knife : and although it will be said, that many authors do not report their unsuccessful cases, yet it is evident that a great many of them were very bad cases : yet 47 or ⅗ recovered ; and over and above the 80, four cases recovered by a kind of natural operation —spontaneous sloughing.

In six instances, reduction was well effected by taxis ; and therefore no operation was required.

In three, the taxis succeeded ; but the patients died with a dark convolution. An earlier operation might have saved them.

In two, the reduction " *en bloc*" was fatal. (Vid. Nos. 80 and 81.)

In four, there is good reason to exclude them altogether. (Vid. Nos. 82 and 83 ; 77 and 78.)

against their patients. Some recorded cases almost invite a harsher criticism. If my patient should sink after the treatment recommended by Mr. Lawrence—(and, under some circumstances, I should probably adhere to his plan with little reserve), what might not a keen physiologist suspect? The longer the patient survived, short of recovery, the more he might see room to condemn the incessant purgation.*

Let the reader consider the subjoined plan, as having been put in practice with good opportunities to persevere, but finally unsuccessful after a hard struggle; and can he doubt that such treatment must distress and overwhelm:—and is it

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* "After the operation, sometimes the bowels are spontaneously relieved, and a considerable abatement of the symptoms in general ensues. More commonly, it is necessary to solicit the action of the intestinal canal by aperients and injections. If, therefore, the bowel should not have been relieved in three or four hours, a few grains of calomel may be given, in a pill; or two pills may be administered, consisting of calomel and the compound extract of colocynth, in equal parts. The sulphate of magnesia may be given afterwards, in doses of one or two drams in infusion of roses, or in a mixture of mint-water and common water; and this should be repeated every three or four hours, until the bowels are freely relieved. If this desirable result should not occur, after a second dose a large common injection should be thrown up, with the addition of four or six ounces of infusion of senna, or one ounce of castor-oil. We must repeat these, or similar means, and persist in their employment until the canal is completely unloaded; remembering, that the intestines frequently contain a large collection of fecal matter and of morbid secretions, which can only be got rid of by several copious motions; and that the operation of purgatives must be necessary, not merely by removing this noxious accumulation, but by exciting a discharge of fluids calculated to lessen inflammatory action. The notion, that purgatives are capable of exciting the mucous membranes of the alimentary passages, and thus of producing or aggravating inflammation of the stomach and bowels, and the prohibition of their employment on this account, both after operation for strangulated hernia, and in many other cases, is, in my opinion, entirely groundless; and the practical precepts founded on this theoretical and imaginary foundation have always appeared to me a signal triumph of doctrine over the most unequivocal results of experience, and the plainest dictates of common sense.

"Until the bowels have been unloaded, and all risk of inflammation has passed by, the patient should be confined to liquids; such as, toast-and-water, barley-water, tea, thin gruel. A light sparing diet should be enjoined until recovery is complete. The stomach and intestines continue irritable for some time; so that any deviation from this rule brings on disorder, and impedes the process towards recovery. Many cases have ended fatally, and great danger has arisen in others, from neglect and imprudence in this respect."

LAWRENCE, p. 322. Fifth Edition.—*Ruptures.*

not much the same, when a patient only survives the operation long enough to swallow down two or three quickly successive doses, which are positively distressing to a delicate person in health? I am glad to know, that some moderns entertain much suspicion about the agency of mercurials, when there is a tendency to unorganizable effusions, as in the present case: and I cannot but avow, that, according to my own experience when patients are dead, there is truly every now and then room to reflect how far the active remedies in common use may have been concerned in exciting disturbance, or accelerating the unfavourable termination.

Let us observe, for a moment, the state of perhaps three-fourths of the small bowels, after an unsuccessful operation for strangulated hernia;—distended, fleshy, and inflamed, throughout its whole extent and thickness, in a state of the most exalted irritation; full of gases and fluid, very closely resembling, or rather even surpassing, the condition of fatal cholera; and manifesting, that if any thing can add to their excitement, it can scarcely be by an immediate increase of action, but rather by a prolonged continuance of it. This is not applied to the healthy parts of the canal, which experience shews to be empty and quiescent.—Let us next consider the prostrate condition of the body generally; or perhaps it may be a state of fever, or latent excitement, which we fear.—And now, may we not well seek for gentle remedies?

The employment of tobacco may not only be at once deleterious, as has been acknowledged, but, also, it may be, I conceive, mischievous in a secondary manner; leaving the patient in a less favourable state to overcome the evils whose nature I have endeavoured to elucidate. Some authors offer a large experience against the utility of tobacco. But it is my object to leave the entire consideration open; and not, whatever the appearance may be, to come to any conclusions contrary to common experience, without good authority, which can only be gradually obtained by much watchfulness from experience itself.

I hasten to conclude with a summary of the preceding observations:—

First—Most herniæ being of old standing before they

become seriously strangulated, this result is not attributable to the state of the sac, but to that of the bowel; in which, defective nourishment and power of vessels leads to more ready tumefaction;—and all this seems attributable to the age and the organic deterioration belonging to it.

2dly—The common and chief danger is from a peculiar and unhealthy kind of peritonitis; the consequence, probably, of the same constitutional decay or decline of organs which induced the strangulation.

3dly—The above facts lead to the conclusion, that prompt surgery, to remove the cause of inflammation, and the most cautious medicine to obviate and not excite inflammation, and to add nothing to the oppressed condition of the patient, are indications even more pressing than has been commonly maintained, at least among authors and the generality of surgeons.

CHEMICAL EXAMINATION

OF THE

LIQUOR AMNII.

BY G. O. REES, M. D. F.G.S. &c.

THIS secretion has been examined by several continental chemists, with a great diversity of result, not only as to the quantities, but likewise the quality of its constituents.

Buniva and Vauquelin make its specific gravity 1004; and its solid contents, 11 to 12 parts in 1000. Frommhertz's experiments differ from the late observations of Dr. Vogt of Bern; who attempts to explain the discrepancy, by supposing that the fluid, as examined by Frommhertz, was not obtained pure.

In a Paper on Albuminous Fluids, by Dr. Bostock, published in the Fourth Volume of the "Medico-Chirurgical Transactions," the solid content of a specimen of liquor amnii is given as 16.6 in 1000 parts; which would make the specific gravity of the fluid to be about 1008.6. This observation is in close accordance with my own; the four specimens I have examined varying in specific gravity between 1007 and 1008.6.

The analyses I here bring forward were performed on specimens of liquor amnii procured for me by my friend Mr. C. W. Lever, to whose kindness I am indebted for the particulars I shall prefix to each analysis. Great care was taken by that gentleman that no extraneous matter should become admixed with the liquor, which was drawn off either by a canula or a female catheter.

CASE 1.

C—— W—— has been delivered of three children. In the two first labours, the perforator was employed, to effect delivery. The third labour was brought on at 7½ months—the child born dead. On examination, the brim and outlet of the

pelvis were found by Mr. Lever to be contracted: he therefore again induced labour at 7½ months, by passing a female catheter into the os uteri, and drawing off the liquor amnii. Labour pains came on twenty-four hours after the operation, and in forty-one hours a female child was born alive: it lived only half an hour.

EXAMINATION OF LIQUOR AMNII.

Strongly alkaline.—Sp. grav. 1008.6.

Contained in 1000 parts:

Water	983.4
Albumen (traces of fatty matter)	5.9
Albuminate of soda Chloride of sodium }	6.1
Animal extractive soluble in water and alcohol, urea, chloride of sodium	4.6
Traces of alkaline sulphate.	

CASE 2.

R— H—, a patient admitted into Bermondsey Workhouse, had been in great distress previous to admission: had had three children: supposed herself about five months advanced in pregnancy: was greatly emaciated, and suffered from colliquative sweats, coughs, and expectoration. She sunk gradually. On post-mortem examination, large vomicæ were found in the apices of the lungs: the abdominal viscera were healthy. The liquor amnii was carefully drawn off; and the fœtus (a female) appeared to be at about the seventh or eighth month of utero-gestation.

EXAMINATION OF LIQUOR AMNII.

Strongly alkaline.—Sp. grav. 1008.

Contained in 1000 parts:

Water		984.98
Albumen (traces of fatty matter)		1.80
Extract soluble in water	{ Salts 2.80 Organic matter, principally albumen, from albuminate of soda, 3.22 . . . . }	6.02
Extract soluble in water and alcohol	{ Salts 2.80 Organic matter, principally lactic acid and urea, 4.4 . . }	7.20

The third specimen examined, was taken from the same patient as specimen 1. The liquor was abstracted in the same manner, and at the same period of utero-gestation (7½ months). The fœtus was a female, and still-born.

EXAMINATION OF THE LIQUOR AMNII.

Strongly alkaline.—Sp. grav. 1007.

Contained in 1000 parts:

Water . . . . - . 996.8
Albumen (traces of fatty matter) 3.2
Aqueous extract { Salts 3.2 / Organic matter, viz. albumen, / from albuminate of soda, 1.2 } 4.4
Alcoholic extract { Salts 3.8 / Organic matter, viz. lactic acid / and urea, 1.8 . . . . . } 5.6

CASE 3.

Mrs. W——, advanced 7½ months in utero-gestation, of diminutive stature, being only four feet four inches in height, has had one child, which was brought away by using the perforator. She has suffered from rachitis in early life. There is considerable abbreviation of the antero-posterior diameter of the pelvis. The liquor amnii was drawn away from the membranes by a female catheter. The child was brought away by using the perforator.

EXAMINATION OF THE LIQUOR AMNII.

Strongly alkaline.—Sp. grav. 1007.

Contained in 1000 parts:

Water 996.8
Albumen (traces of fatty matter) . . . . 2.4·
Aqueous extract { Salts 4.2 / Organic matter, viz. albumen, / from albuminate of soda, 2.0 } 6.2
Alcoholic extract { Salts 3.0 / Organic matter, viz. lactic acid, / and urea, 1.6 . . . . . } 4.6

The fatty matter procured from the liquor amnii differs from that of the blood, in not assuming a deep purple tint when digested in strong sulphuric acid.

The salts, both of the aqueous and alcoholic extracts, consisted of chloride of sodium and carbonate of soda, with minute traces of an alkaline sulphate and phosphate. In the salts of the aqueous extractive, the carbonate resulted from the incineration of an albuminate; and in the alcoholic extractive, from the decomposition of a lactate, by the same operation.

The salts obtained from the aqueous extractive in analyses Nos. 2 and 3 were not entirely soluble in water. The insoluble matter, on examination, proved to be phosphate of lime; which must either have been held in solution with the albuminate of soda, or have resulted from the decomposition of an alkaline phosphate at a red heat; some soluble earthy salt being present, to effect such decomposition. I lately observed the existence of phosphate of lime in the aqueous extractive of a specimen of blood drawn from a diabetic patient; and am inclined to think that further observations will shew a similar result in other albuminous fluids. I should be inclined to ascribe the presence of the earthy phosphate to the existence of some soluble earthy salt in the aqueous extractive, which, when fused with phosphate of soda, yields phosphate of lime; and I am strengthened in this opinion by the fact, that when the salts, after incineration, were not allowed to fuse, no earthy phosphate was observed; and traces of an alkaline phosphate were detected in the aqueous solution of the salts, which was not the case when the earthy phosphate was present.

Urea was proved to exist in the liquor amnii, by its characteristic crystallization with nitric acid, and the re-actions of its nitrate. A further evidence was obtained in the analysis of Specimen 3, by the crystallization of chloride of sodium in octohedra, from the alcoholic extract, when allowed to evaporate spontaneously. Specimen 3. contained urea, in greater proportion than the other specimens.

The albumen procured from the liquor amnii yields a trace of oxide of iron and earthy phosphate, on being incinerated.

The flocculi which are observed floating in the liquors are composed of caseous matter, containing cholesterine.

On examining the analyses, it will be observed that the

liquor amnii varies greatly in proportional constitution in different individuals, at the same period of utero-gestation; which shews, that, like perhaps all the secretions of the body, it is affected by the temperament and diathesis of the mother. The specific gravity of the secretion, however, varies but little in the four specimens; which is possibly a precaution on the part of nature to preserve a medium of fixed power, to oppose the motions of the fœtus in utero.

Whether or not the liquor amnii varies in concentration at different periods of utero-gestation, remains to be shewn: it is certainly pretty constant at $7\frac{1}{2}$ months.

The experiments of Dr. Vogt of Bern would lead us to suppose that there is great variation in the density of the fluid at different periods. At six months, that chemist asserts that he has found 9.71 parts of solid matter in 1000 of the liquor; and at $3\frac{1}{2}$ months, 20.55 parts in 1000. There is, however, a want of proper relation between the solid content and specific gravity of the fluids, as given by the Doctor, that prevents me from regarding his experiments as conclusive.

on

DIABETIC BLOOD.

BY G. O. REES, M.D. F.G.S. &c.

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THE experiments of some of the most careful and expe-
rienced chemists have failed to detect sugar in the blood of
diabetic patients; and up to a very recent date, it was
supposed that the serum was free from contamination, even
in the most virulent and lengthened cases of diabetes. Some
late experiments, made by Mr. M'Grigor of Glasgow, seem to
shew that sugar is present, not only in the blood and urine,
but likewise in several secretions and excretions. The re-
actions obtained by that gentleman certainly rendered it very
probable that sugar was present; but I am not aware that it has
ever yet been separated, in its characteristic form, from the
serum of diabetic blood; except by Ambrosiani, who relates a
method by which he succeeded in extracting it in a crystal-
lizable state. His process is as follows. The blood is to be
diluted with water; and boiled, in order to separate as much
as possible of the albumen and hæmatosine: the clear liquor
is then filtered away, and precipitated by di-acetate of lead.
The excess of lead is to be removed by a stream of sulphuretted
hydrogen gas; and the precipitate being allowed to settle, the
liquor is to be poured off, cleared by being boiled with white
of egg, filtered, and evaporated to the consistence of a syrup:
this, on being allowed to remain exposed to the air for some
weeks, deposits crystals of diabetic sugar. By this process,
Ambrosiani asserts that he has succeeded in extracting sugar:
and though I have not followed his process, yet I am inclined
to consider it calculated to afford a satisfactory result; for I
have observed that the presence of urea in the blood of

diabetic patients interferes with the demonstration of the sugar; and the performance of this process would tend greatly to destroy that principle.

The method I have adopted will yield sugar of considerable purity; though it will not enable us to determine, with precision, the weight of the principle. The process is as follows:—

The mass of blood* is to be evaporated to dryness, over a water-bath; the dried mass to be comminuted, and digested for several hours in boiling water: the aqueous solution is to be filtered off, evaporated to dryness, and the dried residuum digested in alcohol of sp. gr. 0.825: the alcoholic solution so formed is to be filtered, or carefully poured off, evaporated to dryness, and the dry mass treated several times with rectified ether, which dissolves out urea, and also some fatty matter; leaving behind the sugar, in admixture with osmazome and chloride of sodium: this mass, on being dissolved in alcohol, and the solution allowed to evaporate spontaneously in a flat glass dish, affords mixed crystals of alkaline chloride and diabetic sugar; which are easily distinguishable from each other, and allow of being separated mechanically, by shaking them up in alcohol, when the chloride sinks; and the sugar, being principally collected above, may be removed, for examination, by careful use of the spatula: the alcohol must not, of course, be allowed to remain long in contact with the crystals, as it would re-dissolve them. It is a matter of surprise to me, that sugar has not been long ago detected in the blood of diabetic patients, though not separated from it; for the alcoholic extract of the serum, when mixed with water, will, after a few days, give off carbonic acid; which, in addition to the sweetish taste, and, I may add, syrupy smell of the evaporated alcoholic extract, is a sufficient evidence of the presence of sugar. I subjoin the analysis of 1000 grains of diabetic serum, obtained for me by the kindness of Dr. Bright. The sp. gr. of this patient's urine was 1048; and the contents of the serum as follows:—

* 12 ounces were used in these experiments.

Water	908.50
Albumen (yielding traces of phosphate of lime and oxide of iron, on incineration).	80.35
Fatty matters	0.95
Diabetic sugar	1.80
Animal extractive, soluble in alcohol, urea	2.20
Albuminate of soda	0.80
Alkaline chloride, with traces of phosphate . . . Alkaline carbonate, and trace of sulphate, the results of incineration	4.40
Loss	1.00
	1000.00

I should wish the proportion of diabetic sugar given here to be considered merely in the light of a close approximation; as it is impossible to separate it completely from impurity; and, moreover, the loss sustained by it during manipulation, which must be considerable, does not admit of estimation.

The alkaline salts contained a trace of an earthy phosphate in admixture; which is a curious fact, to which I have alluded in my paper on the analysis of the liquor amnii.

It will be observed, on comparing this analysis with that of the serum of healthy blood, that we have here a great excess of matters soluble in alcohol, while the albuminate of soda is rather less than in health. The alkaline salts are also in very small proportion, being only 4.40 gr. in 1000 grains of serum, while in health they amount to from 7 to 8 grains per 1000.

I attribute my success in obtaining sugar, in its characteristic form, from diabetic blood, principally to the use of ether, which extracts from it the urea and fatty matter. I find that the ether of the shops of sp. gr. 0.754, which of course contains some alcohol in its composition, is an active solvent of urea, while it exerts no action on the diabetic sugar.

OBSERVATIONS

ON

ABDOMINAL TUMORS

AND

INTUMESCENCE:

ILLUSTRATED BY CASES OF DISEASE OF THE SPLEEN.

WITH REMARKS ON THE GENERAL PATHOLOGY OF THAT VISCUS.

BY R. BRIGHT, M.D. F.R.S.

PHYSICIAN EXTRAORDINARY TO THE QUEEN.

THE spleen is an organ which, both from the obscurity in which its natural functions are involved, and from the situation which it occupies in the body, presents, when diseased, some difficulties, in regard to diagnosis, which are not shared by many other organs. Moreover, its healthy condition probably admits of so much variety, and so many changes, as to bulk and consistence, that, in a pathological point of view, it is not always easy to mark out the limit at which morbid change or degeneration of structure actually begins.

The situation occupied by the spleen is a portion of the left hypochondriac region: attached to the stomach and the pancreas, its lower angle touches the left kidney, while its convex surface fits into the concavity of the diaphragm. Thus, in its healthy condition, it is hidden from our view, and put beyond the reach of our usual modes of investigation; having the ribs and a portion of the diaphragm so placed, as to prevent us from approaching it, on the one side, and the stomach and the colon on the other.

Its most usual appearance, after death, is an irregular flattened oblong body, varying in size, from that of half a lemon divided longitudinally, to four times that size; with a decided concavity towards the stomach, to which it is attached by vessels; and a decided convexity towards the diaphragm,

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against which it plays freely, without any attachment. Its colour is a purple, more or less dark in its shade, and of a somewhat silvery hue: its surface is sometimes smooth and polished; at others, corrugated: when smooth, the organ is firm and elastic to the feel: when corrugated, it is flaccid: when squeezed firmly between the fingers, the internal texture generally gives way, breaking down under strong pressure; while the tunic with which it is invested, and the peritoneum, remain undivided.

With regard to the functions of the spleen, we have every reason to believe that it affords important assistance in preparing the blood; but whether chiefly as accessary to the process of digestion, or as having within itself the power of acting beneficially on the blood, I shall not now consider it necessary to inquire: it is an established fact, that it is provided with a structure which affords it peculiar elasticity, so that it can accommodate itself to great changes in the volume of the blood it contains.

That this power has reference to the varying quantity of blood with which it is supplied in the discharge of its duties, there can be no doubt; and the cellular, or, as I might almost say, the sponge-like arrangement of its parts, when coupled with its elasticity, plainly shews to what an extent its bulk may be expected to vary, under the ordinary circumstances which demand the filling or the emptying of its cells. From these considerations, it is obvious that, in the same individual, the healthy organ varies greatly in size: but besides this, the variety, as regards different individuals, is still more striking; and we have, in the Museum of Guy's, a specimen weighing only thirteen drachms and ten grains; while another, apparently healthy spleen, in the same state, weighed nearly two pounds. Still, however, great as this variety is, and great as is the occasional increase of this organ, it perhaps never, in its healthy state, descends below the margin of the ribs, or becomes sensible to the touch in that part of the abdomen.

Like other organs, the spleen is subject to a variety of structural alterations, more or less permanent.

1. *Simple Congestion.*—In this condition, it would appear that the blood, having gained access to the cells, and over-

distended them, the elastic power of the organ is too weak to send it forward; and the accumulation, consequently, goes on as far as the proper tunic and the peritoneum will permit. The spleen, in this case, retains its natural structure; and is, for a time at least, capable of being completely relieved. This condition of the spleen is probably often produced by repressed perspiration, and sudden or long-continued cold: it occurs, in a more permanent way, after some continuance of intermittent fever. (Plate I.)

2. *Congestion with enlargement, and probably partial organic change—the spleen still apparently able to discharge its function.* —In this state of disease, although the viscus is obviously and often greatly enlarged, yet, from the fact, that the constitution does not materially suffer, that the countenance remains healthy, and that the spleen is subject to occasional fluctuations as to size, there is reason to believe that portions, at least, of the viscus, and most likely the whole, partially admits the usual passage of the blood. (Plate II.)

3. *Fleshy hardness.*—The organ is completely altered in its texture and characters: it becomes firm to the touch, cutting with as much resistance as an half-ripe apple, and the cut surface yielding the lustre of a firm damson-cheese; and sometimes, the cut surface presents numerous opake whitish granules, apparently from thickened cellular membranes. It is probable that this condition is the result of chronic inflammation, or of frequent congestion; but as the spleen is often not materially enlarged, it happens that, in the present state of our knowledge, we have no means of ascertaining its induration during life.

4. *Fleshy hardness, with enlargement.*—In this state, the spleen often attains to a prodigious size, filling up the whole left side of the abdomen. It produces very little constitutional irritation, and chiefly injures by its bulk, and its tendency to favour serous effusion. It is astonishing with what rapidity this enormous growth occasionally takes place; but in this respect we are liable to be deceived, for it is attended by so little pain, that, in many cases, the increase has been taking place, gradually, long before some accidental circumstance leads to its discovery. In young children, this form of disease is still more frequent than in

adults; and with them it is more fatal. It often begins to
shew itself at two or three months of age, gradually increas-
ing, till it bears a very large proportion to the whole contents
of the abdomen; and is to be traced quite into the pelvis, and
extending far beyond the linea alba, towards the right side.
In these cases, it is often attended with the appearance of
petechiæ all over their cadaverous and pale bodies. Such
children seldom live above a year, or two or three; and fall
victims to emaciation, and often to mesenteric disease.

5. *Softening.*—This condition may exist in various degrees,
and may depend on different causes. It is sometimes rather
the result of rapid change after death, than of disease. Where
the colour of the organ is that of a deep venous blood, pro-
bably congestion and cadaveric change may be inferred; and
where a lighter lilac colour, or a mottled red and lilac, is
observed, it has been supposed to bespeak some form of
inflammatory action.

6. *Inflammation.*—How much of the enlargement, and the
permanent hardening and softening, of which I have just
spoken, may be the result of inflammation, and how much
of congestion often repeated, may be matter of doubt; but
that the spleen is subject to inflammation in its substance,
like other organs, is certain: and although, from its peculiar
character and colour, it is not easy to point out its appearance
under recent inflammatory attacks, we have reason to sup-
pose that certain alterations, with regard to its general vas-
cularity and its consistence, must be so produced; and,
perhaps, as I have said, the red and mottled lilac colour,
accompanied with a degree of turgescence in the organ, indi-
cates a state of inflammation.

7. *Suppuration.*—This proof of inflammatory action, though
not very frequent, has come under my notice, in a distinct
manner, two or three times. The spleen, under such cir-
cumstances, is apt to contract adhesions with neighbouring
viscera; and either form a kind of shut sac by their assis-
tance, or ulcerate through into some of the hollow viscera,
as the colon or the stomach, and thus effect the discharge of
the abscess without material injury to the peritoneum.

8. *Gangrene.*—This effect of inflammation is likewise occa-
sionally found in the spleen.

9. *Tubercles.*—The substance of the spleen is occasionally sprinkled with genuine tubercles. They are often very regularly distributed through the whole substance; and, whether more or less frequent, seem to occupy every part equally. They are sometimes solid and hard; but very soon incline to soften at their centres, and early present the appearance of curdled matter contained in little cysts. The tubercles in the spleen are generally, but not always, accompanied by similar deposits in other organs, particularly the lungs and mesenteric glands: and the tubercular diathesis, in very young children, more frequently shews itself in the spleen than in persons of more-advanced age; and seems to bear proportion rather to the disease of the glandular system, than of the lungs. (Plate III. Fig. 1 & 2.)

. 10. *Malignant Disease.*—The true malignant tuber, both scirrhous and cerebriform, such as is found in the liver, is sometimes met with in the spleen; where, as in the liver, it probably occupies the cellular membrane; gradually insinuating itself extensively through the substance of the organ, but having a tendency to the formation of rounded masses. (Plate III. Fig. 3.)

11. *Melanosis.*—The spleen, in common with almost all the organs of the body, is subject to this form of malignant disease. In the Military Museum of Fort Pitt, to which pathologists are every day more and more indebted, is a fine preparation illustrative of this fact.

12. There is another form of disease, which appears to be of a malignant character, though it varies from the more usual forms of malignant disease; and which has been particularly pointed out by Dr. Hodgkin, as connected with extensive disease of the absorbent glands, more particularly those which accompany the blood-vessels. The whole of these absorbent glands, or large masses of them, become large and firm; without any tendency to suppuration, as in ordinary scrofulous disease; or to soften, as in cerebriform disease: and, at the same time, the spleen becomes more or less completely infiltrated, throughout its whole substance, with a white matter of almost the appearance of suet. This matter insinuates itself into the cellular structure of the spleen; but it is no easy matter to point out what particular portion of the

stricture receives it. A section of the organ seems to shew, from the irregular forms assumed, that it fills a cellular structure, and, in some degree, takes its shape from the cells into which it enters; having less tendency to assume the form of regular globular masses or tubera than other malignant disease. (Plate IV. Fig. 3.)

13. *Fibrinous deposits, most probably from extravasated blood.* —In several cases, it has been observed, in the examination of bodies, that the spleen has presented, when first brought into view, in the middle of its structure, a large mass, or sometimes two masses, of a yellow fibrinous matter, of uniform consistence. In some cases, these have had all the appearance of being the remnants of blood, thrown out, either like an apoplectic clot, or from the rupture or laceration of the spleen : they have sometimes presented, towards their edges, some appearance of an unconverted clot : they have not appeared to be in any state of active progress : they have gene- rally been larger on the part seen externally, diminishing inwards, as might be expected if they had filled up a fissure or rent in the substance. In some cases, the tunic of the spleen has not been distinctly to be traced ; but in others, the peritoneum, and perhaps the proper tunic, have seemed to pass uninjured over the yellow mass. (Plate IV. Fig. 1 & 2.)

14. *Bony deposits.*—It now and then happens that small rounded masses of bone are found in the very centre of the spleen ; and in the only case I have recorded from my own experience, bony deposit was also found in some of the mesenteric glands ;—a fact which is somewhat curious, as connected with the facts I have already stated respecting the frequent coincidence of mesenteric scrofula with tuberculated spleen ; and of a certain modification of malignant disease in the absorbent glands, with a corresponding disease in the spleen. (Plate V. Fig. 1.)

15. *Cellular degeneration.*—There is an occasional appearance presented by the spleen; which I have also seen both in the liver and the kidney, where cells are developed, as if in the cellular membrane, filled with serous fluid. From these appearances, we should be inclined to suppose that they were of little importance, and only likely to interfere with the functions of the organ when they have occupied a much larger

portion of it than I have ever witnessed. (Plate V. Fig. 2.)

16. *Hydatids.* — The true acephalocyst hydatid is found occasionally involving, or arising from, the spleen ; but by no means so frequently as from the liver. I have related, in a former number of these Reports, a fatal case of an hydatid in the spleen bursting into the abdomen.

17. *Laceration.*—It happens, in cases of violent injury, not unfrequently, that the spleen is ruptured ; and, in this case, hæmorrhage may take place in the abdomen, and the patient die : this accident will be more likely to occur if the injury be inflicted when the spleen is in its turgid state. There are instances of laceration taking place without external injury ; and the late Dr. Babington related to me a case where he had examined a patient after death, in whom the spleen had been completely detached, and was found loose in the pelvis. In that case, most violent sickness had taken place ; and was believed to be the cause, not the consequence, of the spleen being torn from its attachment.

18. *Supernumerary spleens.* — It may be right to mention, that it is by no means uncommon to find one, two, or three small spleens, from the size of a filbert to that of a walnut, quite separated from the large spleen. It is also said, but I cannot confirm it, that the spleen has been entirely wanting.

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The peritoneal covering of the spleen is subject to all the usual alterations observed in other portions of that membrane. It may be vascular, from inflammation or congestion : it is subject to ecchymosis, adhesion, fibrinous deposit on its surface, cartilaginous deposit, and bony deposit. It may also be covered with tubercular matter, and with different forms of malignant growth.

1. The spleen does not, in general, shew the *vascularity* of its surface so obviously as many other parts covered with peritoneum ; and it is not common to find the membrane subject to marked vascular turgescence. Occasionally, however, that part of the peritoneum is most acutely inflamed, and the vessels sometimes distended.

2. *Ecchymosis.*—This condition is most frequently the result of accident, blows, and falls, accompanied by contusions or lacerations of the organ : but, besides this, it is sometimes

seen as the result of disease; as when, in some cases of dropsy, the peritoneum has extensively put on the hæmorrhagic tendency; and this is more particularly favoured by organic changes in the spleen and liver.

3. *Adhesion.*—This result of inflammatory action is very frequently seen in the spleen, so that considerable force is necessary to draw it forward: and, in doing so, the peritoneum is often lacerated before the adhesion will give way.

4. *Fibrinous deposit.*—The surface of the spleen is often found covered with fibrinous deposit, when inflammation has existed in the peritoneum; for, owing to its dependent position when the patient is lying on his back, it happens that the deposit has an opportunity of accumulating about it, and fixes itself permanently upon it.

5. *Cartilaginous deposit.*—The frequency of this occurrence is somewhat peculiar to the spleen; for there is no other organ so often found to be covered with a partial cartilaginous coating. The convex surface is the most frequent seat of this appearance. Sometimes the whole is covered with an even, shining coat of cartilage; at other times, it is distributed in masses of larger or smaller size, with intervening spaces; and sometimes it will be found nearly a quarter of an inch in thickness. This deposit seems to belong to the peritoneal coat, in the substance of which, or on its surface, it is probably formed: and it does not materially interfere with the elasticity of the proper tunic; so that I have seen a spleen covered with a coating of cartilage of extraordinary thickness, which had contracted so as to bring the cartilaginous covering, which was incapable of contracting, into numerous folds. It is probably owing to the situation of the spleen favouring the accumulation of fibrin on its surface, and the peculiar and constant motion to which it is subject, in accordance with the motion of the stomach, and its own distention and contraction, that these cartilaginous patches are so frequent on its surface.

6. *Bony deposit.*—Occasionally, the change which takes place in the deposit goes one step further; and in portions of the cartilage, plates and spicula of bone are formed, or even a complete bony case.

7. *Cicatrices.*—It is not unusual to see appearances like

scars, from healed lesions, upon the surface; and these some-
times penetrate quite into the substance.   There is no reason
to doubt that these are, then, results, either of accidental
injuries, or of inflammatory and, in some cases, perhaps, sup-
purative action.

8. *Tubercular deposit.*—When the tubercular diathesis is
strong, and the serous membranes take on the action, or, as
more frequently happens, when the newly-deposited products
of inflammation receive the tubercular deposit, the spleen is
often covered, either by a coating of such matter, or by
innumerable miliary tubercles.

9. *Malignant deposit.*—The peritoneal coat of the spleen,
and the cellular membrane beneath it, receive the different
forms of malignant growth; sometimes the pendulous cysts
and tubera, sometimes the creeping flat circular deposits, and
sometimes the general even deposit of this kind.

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Looking for the symptoms from which disease in the
spleen is to be inferred, we find ourselves confined within
very narrow limits.   We know of no decided function which
the spleen has to perform, of such a character as to direct us
to the defect under which the system labours.   We know of
no secretion which it furnishes, nor of any excretion which
it immediately influences: we therefore cannot be guided
by any observations bearing upon these points.   From expe-
rience we know, that, not unfrequently, certain splenic dis-
eases are concomitant with a peculiarly unhealthy, sallow, and
anæmial character of countenance: we also know, that, not
unfrequently, an hæmorrhagic tendency is an accompaniment
of such disorders: but neither of these are sufficiently de-
fined; nor are they sufficiently limited to affections of the
spleen, to furnish more than a clue in the investigation: and
probably the local symptoms are those to which we shall turn
with the greatest advantage.   These local symptoms are
pain, tenderness on pressure, and tumors.   The pain is seldom
acute, unless the peritoneal coat of the organ is inflamed;
and then, owing to the proximity of so many other parts, as
the heart, the lungs, the diaphragm, the stomach, the kidneys,
the colon, it is very difficult to localize; although, by the

method of abstracting one by one of the organs, in proof of
the lesions of which certain other symptoms are wanting, we
may come to the conclusion that the pain belongs to the
spleen.   There is a dull and tensive pain sometimes com-
plained of; but this, in general, does not occur till the tumor
is already capable of being felt.   The tenderness induced by
pressure seldom leads us to the exact seat of disease, before
the situation and circumstances of the tumor have already
sufficiently explained its character.   In most cases of splenic
disease, there is neither pain nor tenderness; but when the
organ is inflamed, it becomes intensely tender.   The tumor
is the most decisive indication; and in many cases it is
scarcely to be mistaken : the character is, a smooth, oblong
solid tumor, felt immediately beneath the integuments, pro-
ceeding from under the ribs on the left side, a little behind
the origin of the cartilages; often advancing to the mesial
line in one direction, and descending to the crest of the ileum
in the other; often filling the lumbar space, at its upper part.
This tumor is very generally moveable; feels rounded at
its posterior part; and presents an edge more or less sharp
in front, where it is often notched and divided by fissures.
If effusion takes place into the peritoneal cavity, a thin layer
of fluid is early felt between the integuments and the tumor,
but the intestines are not at any time found passing before
the tumor.

The chief tumors which may be mistaken for an enlarged
spleen, are, chronic abscess of the integuments—scirrhous
thickening of the stomach—enlargement of the left lobe of
the liver—diseased omentum—feculent accumulation in the
colon—diseased kidney—ovarian dropsy—hydatids.

Chronic abscess beneath the integuments has sometimes
shewn itself so precisely in the situation below the cartilages
of the ribs which is occupied by the enlarged spleen, that
difficulty has arisen in the diagnosis; but it will soon be
perceived, that the swelling is too superficial, or too soft, to
belong to an internal viscus, and more especially to one of
the solid structure of the spleen.

Scirrhous thickening of the stomach sometimes gives rise
to a tumor, which, from its being obviously deeper than the
integuments, and descending from below the margin of the

ribs, affords the subject of doubtful diagnosis; more particularly, as scirrhous attaching the substance of the stomach, and especially the left extremity, is often quite unattended by vomiting; while, at the same time, it is apt to be attended by a sallowness of complexion, not unlike that which bespeaks splenic disease. In this case, one of the best distinctive marks will be found in the sound elicited by percussion; which, when the stomach is so diseased, is usually clear and sonorous; while the substance is still harder than the enlarged spleen.

The left lobe of the liver is occasionally enlarged, either above, or out of proportion to the right lobe. In this case, the margin of the liver may be traced running towards the right side; while the bilious tinge of the skin and of the urine assist in the diagnosis.

The omentum is often the seat of disease; being either corrugated into a mass, or having scirrhous or scrofulous tubercles developed in its structure. In this case, the tumor much less obviously descends from beneath the ribs—cannot be traced backwards—extends across the abdomen—or is rough, knotted, hard, and uneven.

Feculent accumulation in the intestines is a very great source of difficulty in this diagnosis: for when it takes place in the descending colon and the left portion of the arch, it assumes nearly the situation of the enlarged spleen; and is scarcely to be distinguished, except by the history and by the result of medicine: nor must we, without the most persevering employment of purgatives, hastily conclude that the intestines have been emptied.

The kidney sometimes advances towards the left hypochondrium, and presents a tumor nearly in the situation of the enlarged spleen; but here we shall find, by tracing it backwards towards the loins, that its chief bulk is situated much further back, and that it is much more fixed; so that, if the patient be placed upon his hands and knees, it does not fall forwards with any freedom. On careful examination, by percussion at different times, we shall find that there is reason to conclude that the intestine lies between the tumor and the integuments of the anterior part of the abdomen when the kidney is enlarged, which is not the case with the spleen: besides all which, the history will most likely connect the

method of abstracting one by one of the organs, in proof of the lesions of which certain other symptoms are wanting, we may come to the conclusion that the pain belongs to the spleen. There is a dull and tensive pain sometimes complained of; but this, in general, does not occur till the tumor is already capable of being felt. The tenderness induced by pressure seldom leads us to the exact seat of disease, before the situation and circumstances of the tumor have already sufficiently explained its character. In most cases of splenic disease, there is neither pain nor tenderness; but when the organ is inflamed, it becomes intensely tender. The tumor is the most decisive indication; and in many cases it is scarcely to be mistaken : the character is, a smooth, oblong solid tumor, felt immediately beneath the integuments, proceeding from under the ribs on the left side, a little behind the origin of the cartilages; often advancing to the mesial line in one direction, and descending to the crest of the ileum in the other; often filling the lumbar space, at its upper part. This tumor is very generally moveable; feels rounded at its posterior part; and presents an edge more or less sharp in front, where it is often notched and divided by fissures. If effusion takes place into the peritoneal cavity, a thin layer of fluid is early felt between the integuments and the tumor, but the intestines are not at any time found passing before the tumor.

The chief tumors which may be mistaken for an enlarged spleen, are, chronic abscess of the integuments—scirrhous thickening of the stomach—enlargement of the left lobe of the liver—diseased omentum—feculent accumulation in the colon—diseased kidney—ovarian dropsy—hydatids.

Chronic abscess beneath the integuments has sometimes shewn itself so precisely in the situation below the cartilages of the ribs which is occupied by the enlarged spleen, that difficulty has arisen in the diagnosis; but it will soon be perceived, that the swelling is too superficial, or too soft to belong to an internal viscus, and more the solid structure of the spleen.

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The omentum is often the seat of disease: being ... corrugated into a mass, or having scirrhous or .... tubercles developed in its structure. In this ...... the ... much less obviously descends from beneath the rib, ... be traced backwards—extends across the abdomen. ... rough, knotted, hard, and uneven.

Feculent accumulation in the intestines is a ...... source of difficulty in this diagnosis, for when it ...... in the descending colon and the sit....on of .... assumes nearly the situation of the enlarged spleen; ... scarcely to be distinguished, except in the history ...... result of medicine: nor ..... vering employment of pur...... ... intestines have been emptied.

The kidney sometimes a...... s....... the ... chondrium, and presents a .... the enlarged spleen; but here we shall f...... .... backwards towards the loin, that its ch......... much furth..... ..ck, and that it is much .... if the pati..... ......ed upon his hands ....wa.... .... freedom. On ea...... con.... ......, we shall ....gun.... .....stine lies ... .ey ..... .nor part... ...ll .... . in not th... . will .....

tumor with some such peculiarities in the urinary secretion as will seem greatly to guide our diagnosis.

Ovarian tumors assume, as I have formerly said, the greatest variety of shape; and the hard masses which form in the parietes often mislead us, for a moment, into a belief that some other organs are implicated, and, amongst these, not unusually the spleen: but a knowledge of this fact, and of the general diagnosis of ovarian tumors, will soon correct this error.

Of hydatids I have already spoken: their elastic feel and rounded form will generally distinguish them from enlarged spleen, even when the situation they hold would seem to lead us to a wrong conclusion. They are, however, sometimes attached to the spleen itself.

With a view of illustrating the foregoing statement of the pathological changes to which the spleen is subject, I shall now proceed to select a few such Cases as appear to me most appropriate; and I shall commence by the simplest form of congestion, as presented during an attack of intermittent fever.

CASE 1.

Simple Enlargement of the Spleen, connected with Intermittent Fever.

ELLEN CARTER, aged 20, was admitted into the Clinical Ward, under my care, January 25th, 1832; a single woman, of florid complexion: she had been living for some time in the neighbourhood of Gravesend, in a low marshy district. About one month before her admission, having been out in the rain, she was suddenly seized with cold chills, headache, and general pains; soon followed by heat, and afterwards by perspiration. These paroxysms returned regularly every other day, leaving her entirely during the interval. For the last three days, however, they had recurred daily, at nine in the morning, every alternate day; and in the evening at five, on the intervening day. She had no local pain; but general uneasiness, continued thirst, tongue moist and slightly furred, pulse 120 small, bowels regular, appetite gone.

* Vol. II. p. 439 et seq.

She was ordered to take a little diaphoretic mixture; and nothing else, till a paroxysm should be coming on, when she was to have an emetic of ipecacuanha and tartarized antimony.

27.—Yesterday afternoon, the cold fit having come on with great violence, twenty grains of the emetic powder were given, which produced vomiting of a quantity of yellowish fluid, and instantly brought on the hot stage: a slight perspiration then followed, and she slept pretty well through the night. She complained principally of pain in the head, which has left her this morning: bowels abundantly opened: motions feculent and healthy: pulse eighty, and soft: tongue rather dry and brown: skin warm. The catamenia have not appeared since August.

Habeat Quinæ Sulphat. gr. ij. alternis horis.

28.—Slept well, and feels tolerably well. There is a hard tumor in the left side, descending lower than the level of the umbilicus, which is evidently to be traced beneath the ribs, and is the spleen, slightly tender on pressure: (Plate I. Fig. 1.) bowels not open this morning: pulse 100: skin cool: tongue moister.

Applicentur Cucurbitulæ cruentæ lateri sinistro, et detrahatur sanguis ad uncias decem.
Habeat Pulv. Rhei c̄ Cal. gr. xv. statim.
Rep. Quinæ Sulph.

29.—Slept but little during the night, from pain in the left hypochondrium: cupping gave relief, but the pain returned in the evening: no return of the paroxysm; and she is now perspiring profusely: bowels open: tongue dry and brownish: pulse 80, soft.

Sumat Pulv. Rhei c̄ Cal. gr. xv. statim.
Rep. Quinæ Sulph. gr. ij. ter die.

30.—No paroxysms: good night: the swelling is not so distinct, and there is no tenderness in the part: bowels freely open this morning: tongue moist.

Applicentur Cucurbitulæ cruentæ lateri sinistro, et detrahatur sanguis ad uncias decem.
Rep. Quinæ Sulph. ut antea.

31.—Good night: no paroxysm: spleen much softer, but nearly of same extent: no pain in the part: not above two

ounces of blood could be obtained by cupping: pulse 64 : skin cool: appetite improving: bowels open freely: tongue less dry.

Feb. 1.—Tumor much softer and smaller (Plate I. Fig. 2) : tongue nearly clean.

2.—Improving daily: no return of paroxysm: swelling scarcely to be felt, and no pain in it. (Plate I. Fig. 3.)

6.—Tumor gone.

She remained a few days longer, on account of a slight diarrhœa ; and left the hospital, cured.

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In the following Cases, the enlargement of the spleen has depended on congestion in the first place ; but this has, in some instances, led to permanent change in the structure of the organ.

Case 2.

Enlarged Spleen cured by Tonics and Purgatives.

April 27, 1835.—I was consulted by a gentleman of about 20 years of age, who had lately enjoyed good health, growing stout, and looking peculiarly ruddy. He was in the habit, whenever his bowels did not act for twenty-four hours, of taking a dose of colocynth and calomel, followed by a senna draught. On the 24th, he had first experienced a slight pain in his side, half way between the margin of the ribs and the crest of the ilium ; and woke on the following morning with severe pain in that side, sickness, and bilious vomiting. There was no retraction of the testis, nor pain down the thigh : urine clear, but rather high coloured. On examining the abdomen, when standing erect, there was evidently a greater roundness on the upper part of the abdomen on the left side than on the right; and the ribs were somewhat forced out, giving an almost deformed appearance. Looking at the back, there was rather more hollow in the lumbar space than on the right. Laying him on his back, percussion yielded a dull sound below the ribs, in the usual situation of an enlarged spleen ; but a very clear sound above, apparently in the situation of a portion of the stomach. Placing the hand on the left hypogastric region, a most distinct round tumor was felt just at the margin of the

ribs; and placing the other hand on the lumbar space of the same side, a round tumor was also very perceptible: and when either hand was pressed, an impulse was given to the other by the motion of the tumor, which was evidently an oval mass, more or less long, egg-shaped, with its long diameter from before backward. When he was placed on the hands and knees, the tumor gravitated a little forward. There was slight tenderness, on pressure, on the back part of the tumor.

The exact nature of this tumor admitted fairly of some doubt. It might be the spleen, or the left lobe of the liver, the kidney, the renal capsules, or the colon. The tumor was rather more ovoid than the spleen usually is. It was not likely to be the liver, because it went so far back; and it could not be traced as having any connexion with the right lobe of the liver. The kidney would, by its enlargement, have produced a tumor, extending, in all probability, further downwards: it would also have distended the left lumbar space—and perhaps have produced retraction of the testis, with pain down the thigh. The renal capsule has never, to my knowledge, been enlarged to such a size as this. A deposit of scrofulous matter under the tunic of the kidney, I have known to project more than this; but then it is more immoveable. The colon might, by possibility, present a tumor like this. The left portion of the arch would occupy nearly this situation, if loaded with fæces; and the habitually costive state of the bowels would strengthen the suspicion.

The regular form of the tumor, and its general character, led me to express my full belief that it was the spleen; but I thought it right to give a fair trial to purgatives; and for this purpose ordered the compound scammony powder to be given, and followed by injections of infusion of senna and sulphate of magnesia. I also recommended frequent gentle friction on the tumor.

April 30.—He has been very freely purged; but the tumor remains; and the bowels being emptied, the form of the spleen is more distinctly felt.

I ordered now twelve ounces of blood to be taken, by cupping, from the part; and, as soon as the wounds were healed, a large plaster of the ammoniacum c̄ hydrarg. to be applied; the compound scammony powder repeated occasio-

nally; and two grains of sulphate of quinine to be taken twice a-day.

May 10.—The tumor somewhat softer. I desired him to go on as before; only using the combination of the compound extract of colocynth, the compound galbanum pill, and extract of hyoscyamus, instead of the scammony, as a purge.

June 15.—He has continued the purging, the quinine, and the plaster: has had no return of pain, and feels generally better. The tumor is decidedly softer, and extends much less backwards into the lumbar region. It seems to have advanced a little towards the scrobiculus cordis. I desired him to persist carefully in the use of all his remedies.

July 3.—I can no longer discover any tumor; and, on the most careful examination, is now to be perceived but a slight hardness under the angle formed by the ribs and spine, which is apparently the spleen. He has continued the quinine regularly, and has been obliged to increase the extract of colocynth. The weather having been very hot, he experienced great irritation from the emplastrum ammoniaci c̄ hydrargyro, and has been obliged to leave it off for the last two days. I desired him to continue the treatment, but not to carry the purgatives to the extent of irritating his bowels; and, if necessary, to relinquish the plaster during the hot weather, resuming it as soon as he could.

May 1836.—He called upon me, to report that he had been perfectly well since he last saw me, a period of nine months.

Some months after, a relapse occurred in this case; but the same remedies again restored the spleen to its ordinary size; only, on this occasion, I had the cupping employed two or three times. This gentleman has since remained well.

I have at this time, under my occasional care, a case altogether analogous to the one just detailed, in as far as the very great and apparently sudden increase of the spleen is concerned, and its complete disappearance under the same plan of treatment: but in this case, unfortunately, the relapse which has occurred, has, for the present, bid defiance, not only to the same remedial means, but to the iodine and other powerful medicines. It was from this case that the diagrams

in Plate II. were taken; but they serve nearly as well to shew the progressive decrease in the last case; except, that in that the tumor never descended so low towards the pelvis, but seemed more concentrated in the upper part, as if the spleen had enlarged rather in the hollow of the diaphragm, where it was possibly retained by some adhesions.

Case 3.
Enlarged Spleen in a Child.

In December 1837, I had occasion to examine a child aged two years and four months, who died, swollen to an enormous degree, with anasarca, and in whose abdomen was some serous effusion. This child had never flourished, from its birth; and for the last year the spleen had been distinctly felt, occupying a large portion of the left side of the abdomen. Many petechial spots appeared on various parts of the body:—whether the urine coagulated or not, I do not know. The spleen was found, as it had been felt during life, occupying the abdomen nearly to the pelvis, and extending almost to the mesial line. The liver was healthy: but all the glands of the mesentery were greatly enlarged; were hard, and of a red colour. The kidneys were remarkably hard and white.

I adduce this as an instance of the great size to which the spleen attains, during infancy. The case is a comparatively common one; and more marked cases, in younger subjects, will occur to my readers.

Case 4.
Remarkable Distention of the Spleen without Disorganization. Death from the Effects of Diseased Liver.

George Thomason, aged 23, a tailor, was in Cornelius Ward, in the autumn of 1832, under the care of Dr. Back. I saw him a few days after his admission; and was struck with his prominent abdomen, and the dark dingy tinge of icterus with which he was suffused. I found that the upper part of the abdomen about the umbilicus gave a most distinct hollow sound, on percussion, as he lay upon his back. In the lower parts, about the sides and over the pubes, fluctuation was equally evident. The veins of both sides of the abdomen were much enlarged; but this was most seen upon the left. There was an irregular tumor to be felt, descending from

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beneath the ribs on the left side nearly into the pelvis, and reaching, anteriorly, almost to the umbilicus. This I conceived to be the spleen; and a layer of fluid was spread between it and the integuments. At the same time, the liver was but very indistinctly to be felt; but what appeared to be the left lobe, was just perceptible through the fluid. His tongue was furred, and of an ash colour: his stools light: urine deeply tinged with bile, and of a red tint: lips purple.

It appeared, from the history he gave, that about four years before, while sitting on his board, he had been greatly alarmed, and fell on the ground in a kind of fit: but though the blow was severe, he seemed to have derived no permanent ill from it; but a few months afterwards he found his clothes getting tight about his stomach, and this has continued ever since. About two years before his admission, he was in St. Thomas's Hospital, with slight jaundice; which had continued, occasionally, up to the time when I first saw him; but for the last month, his abdomen had been getting much larger. By the marks of cupping-glasses, it appeared as if the chief pain he experienced, at his first attack, had been in the region of the spleen, rather than the liver, as all the scars were on that side. Very little alteration took place in his condition; but the splenic tumor varied in size, as shewn by some diagrams I made. His abdomen grew more distended, and his colour became more dark and dingy, assuming a green tint. About the 10th of January he expectorated a good deal of blood, which continued several days; petechial spots appeared on his shoulders and arms; and his legs became very painful, from the anasarcous distention: at length he died, on the 20th of June 1833.

SECTIO CADAVERIS, *Jan.* 21, 1833.—The body of a dingy light-green colour; the abdomen greatly distended, but flaccid; and the tumor on the right side was not to be felt.

The cavity of the thorax much encroached on by the fluid of the abdomen, which now pushed up the diaphragm, leaving the abdomen flaccid. The left lung adhered to the pleura; but was healthy, as was the right. The heart I did not see examined: it looked rather large, and was slightly tinged with bile.

On opening the abdomen, the small intestines were found only moderately distended, floating on the surface in the central part, and the colon some way above the umbilicus, with the omentum discoloured, and rather puckered up. The liver lay quite in the hollow of the diaphragm, pushed upwards, and now presenting its edge only. It was small, contracted, hard, and lobulated, in a most extreme degree; the projections of the lobules of a dark olive-green colour; the rest, of a silvery-white grey tint, owing to the thickened and diseased state of the peritoneum. On cutting into the liver, it was evident that the cause of its lobulated and mis-shapen form was the contraction of the cellular tissue. It cut almost as hard as gristle; and the bands of cellular substance appeared running through it, drawing the glandular texture up into nodules. Its colour was a deep olive-green, throughout: a good deal of blood issued from the vessels in the substance of the liver, when it was cut into; and many of the moderately-sized biliary tubes contained bile of a thick consistence and rather mucous character.

The gall-bladder looked clear, as if filled with colourless fluid, or too opake to shew colour: it was distended, containing about three or four ounces of mucous fluid; and it was doubled over upon its duct, forming a kind of valve. The hepatic, cystic, and common ducts, were all much dilated; the cause of their obstruction being apparently several dark-coloured hard enlarged glands about Glisson's capsule.

The spleen was very large, and was plainly the viscus I had felt during life; but now it was flaccid, and evidently ungorged: besides which, the diaphragm being pushed upwards, it had subsided very much, falling back into the lumbar space, and hardly descending there below the level of the umbilicus. The weight of the spleen was three pounds ten ounces, and its structure was nearly natural.

The pancreas was hard; and appeared to have suffered the same contraction of the interstitial cellular tissue that had affected the liver, so that each little lobule seemed distinct and hard. The kidneys healthy: the colon tinged externally by bile, and the small intestines a little. A large quantity of very clear bilious serum in the cavity of the abdomen.

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It is doubtful whether the accident, on which this patient laid much stress in his history, had any connection with his subsequent illness: it is more probable, that the whole depended on intemperate habits, which led to chronic inflammation of the liver and ascites. The important fact, as connected with our present inquiry, is, the unusual size of the spleen, weighing, in its contracted state, no less than three pounds ten ounces, and still retaining somewhat of its healthy structure; which appears the more extraordinary, when we take into account the long continuance of the chronic hepatic disease. That the organ was capable of distending and contracting, appeared from the varying size denoted by the diagrams I made, which corresponded almost entirely with the two diagrams in Plate II. of this communication. The occurrence of petechiæ might lead us to suppose that the spleen had been influential in the symptoms attending the fatal termination; but it is more probable that this was merely a manifestation of that general hæmorrhagic tendency, so conspicuously marked in many cases of long-continued jaundice.

Case 5.
Enlarged Spleen, occurring in a Case of fatal Diarrhœa.

Mary Shorter, aged 42, was admitted into Guy's Hospital, under my care, November 24, 1830, affected with a severe dysenteric diarrhœa, of several weeks' standing. Her complexion was remarkably sallow, her lips pallid, and her eyes glassy, but there was not the slightest tendency to jaundice. The abdomen, as she stood, appeared greatly enlarged; and when in a recumbent posture, there was no difficulty in ascertaining immediately the source of the enlargement, which was evidently the spleen, enormously increased in bulk: it occupied the whole of the left side of the abdomen; and its margin was distinctly to be traced, lobulated in two or three parts, and extending from under the margin of the ribs, inclining rather forwards, so as to advance to the umbilicus, and descend quite into the pelvis. (See Plate VI.) She informed us that she had been subject to a weak state of health for several years, her complexion frequently becoming sallow. She had borne five children: the last was eighteen months ago, the labour being quite easy and natural. Eight weeks

before, she was first sensible of the tumor in the abdomen; which, however, was at that time so large, that she thought it had increased very little since. She complained of some pain in the left side, when she lay on the right; and the tumor was frequently tender in some parts.

I applied blisters over the tumor, and afterwards the emplastrum ammoniaci c̄ hydrargyro; and under these applications the tumor certainly appeared to diminish: but the condition of the bowels was that to which attention was chiefly directed, for she was constantly subject to diarrhœa and dysenteric symptoms: she had likewise pain running down the left leg, from which she often suffered much.

A variety of remedies were administered; but from none did she receive so much decided relief as from the employment of opiate suppositories and injections, with the occasional use of a combination of tincture of opium and linseed-oil; but the relief was only temporary, and she constantly lost ground.

. In the month of March, I began to perceive that effusion was taking place into the abdomen; the fluid was evidently perceptible between the integuments and the surface of the spleen; and in the beginning of May she died.

[I greatly regret that I have lost the notes of the dissection in this case; but the enormous size of the spleen, which had acquired a fleshy consistence, was the most remarkable circumstance, together with the ulcerated condition of the intestines, which appeared to be the chief, if not the sole cause of death.

There can be no doubt that a tumor of this unusual size in the abdomen must have aggravated greatly the disease of the intestines, and may have been early a cause of that want of repairing power which prevented the healing of the ulcers in the mucous membrane of the bowels: it might likewise, in a great degree, have contributed to that embarrassment in the circulation which induced ascites, as the general powers of life sunk under continued disease. It is remarkable, in this, and in many other cases, that the enlargement of the spleen seems to make a rapid progress at first; and then to become stationary, seldom increasing by a continuous and pro-

gressive growth: but I believe the fact to be, that the organ becomes rather suddenly over-distended; and then, being very little sensible of pain under distention, it is not till some casual circumstance leads to the discovery of the tumor that the fact is detected: and then, probably, the distention has already continued so long, that remedies are incapable of acting, in any considerable degree, to expel the blood; and thus the enlargement becomes permanent and stationary, because it is not so much from the result of morbid growth, as from consolidated natural tissue.

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CASE 6.

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Enlarged and Fleshy Spleen, with Chronic Disease of the Liver.
RICHARD DANCER, aged 39, was admitted into the hospital, May 12, 1824, affected with an enlargement of the spleen very obvious to the touch, and ascites; and the veins of the abdomen were much enlarged. He had been all his life a sailor, and much exposed in different climates. He was treated by mercurials and squills, with diuretics; and afterwards by tonics.

He gradually improved; and was so well, that he was about to be presented, when, on exposure to cold, he was affected with peritonitis, and died on the 12th of October.

SECTIO CADAVERIS.—The skin was jaundiced. The peritoneal coat of the intestines was inflamed: there were several pints of fluid in the abdomen. The intestines were covered with a coating of recent coagulable lymph, in shreds. The liver deeply lobulated and puckered; and in some parts presenting an appearance of tuberculation, with vessels ramifying upon it.

The spleen was more than six times its natural size, fleshy and firm, with a cartilaginous patch upon one end.

The omentum, the mesentery, and the mesocolon, were loaded with fat; and besides that, there was a mass, apparently of fat, but almost as firm as cartilage, on the vertebræ, near the brim of the pelvis, to the left side; which appeared to account, in some degree, for the swelling which had latterly taken place in the left leg.

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CASE 7.

Enlarged and Fleshy Spleen, with Chronic Disease in the
Abdomen, Mottled Kidneys, and Albuminous Urine.

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IN July 1837, I was requested by Mr. Meryon to see with
him, in consultation, a gentleman labouring under ascites and
general anasarca. His countenance was slightly suffused
with bile, his skin dry, and his urine highly albuminous, and
considerably loaded with lateritious sediment. There was
no difficulty in pronouncing that the kidneys were diseased,
and that the abdominal viscera were greatly implicated. The
effusion into the abdomen was too great to allow us to feel any
particular viscus. The symptoms had now existed for nearly
four months without alleviation, so that we had no expecta-
tion of prolonging life many weeks. They, however, under-
went various changes; the fluid in the extremities, and at
one time the ascites, greatly diminishing; and at another
time he was so well, as to get out in a carriage for a few
days: but, eventually, the ascites increased greatly, and was
the chief source of our anxiety; plainly shewing, although
the urine continued coagulable, that we had other mischief,
than that connected with the kidney, to contend with. He
survived to the end of December.

SECTIO CADAVERIS.—A considerable quantity of fluid in the
abdominal cavity. Old and very strong adhesions of the peri-
toneum of the liver to the parietes. The substance of the
liver was soft and sodden, but not disorganized. The intes-
tines opake and thickened. The spleen was full eight times
its natural size, and nearly as hard as cartilage. On being
squeezed, when cut through, scarcely a drop of blood escaped
from it. The kidneys were white, where they were not
stained by the decomposition of the abdominal fluid. They
were mottled, very decidedly, but by no means in an advanced
state of that disease. The lungs and the heart were healthy:
there was some effusion into the cavities of the chest.

In cases of chronic disease, particularly of the liver, it is
much more usual to find the spleen, if enlarged, in the hard,
fleshy, and consolidated state which occurred in the last three
cases, than in the almost natural condition in which it was

found in the preceding one: but the fact, that sometimes the spleen is to all appearance healthy when the liver is distinctly indurated and altered throughout its substance—and that occasionally, though enlarged, the structure of the spleen seems natural—and that the most hardened spleens, as in the last case, sometimes accompany livers but little disorganized, proves that there is something more required than the deranging of the liver, to produce this change in the spleen. I may mention, that of the enlarged and indurated condition of the spleen co-existing with a hard contracted and lobulated liver, we have some very marked specimens preserved in our Museum; and it is to be presumed that the change in both bespeaks a state of chronic inflammation.

There is another point, connected with the last case, which deserves remark; and that is, the combination of so much abdominal mischief with albuminous urine: and it is right to mention, that I have known a few cases, besides this, in which enlarged spleen has existed in the same combination, in which the kidneys, though decidedly mottled or granulated, have shewn less altered structure than the severity and circumstance of the disease had led me to expect. In such cases, it is possible that the derangement of the spleen is sometimes an accidental coincidence; and sometimes one result, in common with many others, which assists in bringing such cases to a fatal issue. In a great number of cases of albuminous urine, the spleen has been observed in a perfectly healthy condition: and of the hundred dissections detailed in a former Volume of these Reports, in 64 of which the state of the spleen is noted, 27 are said to be healthy: and the 37 which deviate from perfect health have no uniform defect, six being small, eight soft, ten large and more or less fleshy and hard, and two small and hard: one is mentioned as lacerable, one granulated, and one tuberculated; and the remaining eight in variable degrees of softness or hardness, sufficient to attract a casual remark. It is probable that the remaining 36 of the 100 cases presented at least no very remarkable disease in the structure of the spleen, or the fact would have been stated.

CASE 8.

Abscess of the Spleen opening into the Colon.

ANN CUBITT, aged 25, was admitted into the Clinical Ward, November 10, 1825. She was a young woman, much emaciated, of peculiarly sallow complexion, and anxious countenance. She complained of general uneasiness and pain in the abdomen, more particularly the scrobiculus cordis and right hypochondrium, at which part there was an evident fulness: pressure, and all ingesta, increased the pain and uneasiness of the stomach, which were relieved by vomiting. The food was often vomited, immediately after it was taken: at other times it remained some time before it was rejected. There was, also, occasional vomiting of a bilious fluid, and a constant loathing of food. Pulse 120, small and weak: tongue glossy and dry: skin hard and dry: thirst, headache, occasional heats and chills: some pain in the loins; and the catamenia had not appeared for seven months. There had sometimes been œdema of the lower extremities, particularly after exercise, but there was none at the time of her admission. Bowels sometimes costive; at other times, relaxed: and although much stress was laid upon the diarrhœa, yet, shortly after her admission, we saw some dejections which had a very healthy character. It appeared, from her account, that she vomited blood, to the extent of about a pint, on one occasion, three years ago, but had no return of this since; and her present complaint came on with pain at her stomach, and vomiting, which she dated to the time her catamenia disappeared. I ordered egg wine, and milk and lime-water for drink, in small quantities frequently.

Habeat Ext. Gentian. gr. ij. Sodæ subcarb. gr. ij. Opii gr. ⅓. ter die.

The two first nights after her admission, she had paroxysms of shivering, followed by perspirations, almost like fits of ague. Her motions were frequently thin, watery, and very offensive; but she was able to retain a little more food; and nothing was more agreeable to her stomach than an egg beat up with wine.

Nov. 17. Feels much exhausted, and has had scarcely any sleep. Pulse not perceptible at the left wrist, and scarcely so at the right: great pain in the left hand: it has a bluish

appearance, and is not sensible when touched. The warm
poultice which has been applied to the abdomen has given her
relief. She vomited once in the night, after taking a powder
of the hydrarg. c̄ cretâ. Motions relaxed, and green. She
has seemed to relish some soda-water with a little brandy.
The affection of the left hand increased : it became livid, and
extended above the wrist : then the fingers became black and
gangrenous ; and, gradually sinking, she died on the evening
of the 21st.

SECTIO CADAVERIS.—Lungs and heart sound and healthy. The
liver was much 'enlarged, particularly the left lobe; which,
with the spleen, formed an arch, which embraced and pressed
upon the cardiac extremity of the stomach. The substance
of the liver was hard and granulated, and exsanguine. The
right lobe had contracted slight adhesions to the diaphragm.
The spleen was enlarged, and firmly adherent to the trans-
verse arch of the colon. There was an abscess in the spleen,
involving about half of its substance. On the left side of the
abscess, adhesive matter had been thrown out, so as to form
a complete partition between the healthy and diseased por-
tions. The abscess, from the adhesions of the colon to the
spleen, had ulcerated through the coats of that intestine, and
formed a communication with its interior. The contents of
the abscess had a grumous chocolate appearance : the spleen
had formed adhesion to the diaphragm ; and at this part the
parietes of the abscess were considerably thinner. There was
an abscess in the left ovary, and the cavity of the uterus was
irregular in its surface.

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It is quite obvious, that, in this case, there was nothing
to direct us to a certain diagnosis : and the following short
extract, from a few clinical observations which I read to the
Class the day after I admitted this patient, will shew what were
my views upon that subject, and serve as a pretty just state-
ment of the extent to which we can fairly venture a diagnosis
in cases of such unusual and complicated disease :—

 " This is a case in which the nature of the disease is not
" altogether obvious to me. That something is producing the
" greatest irritability of stomach, is quite evident. The con-
" stant vomiting, which for several months past has never been

" absent for above two days at a time, and the uneasiness she
" experiences after taking food, until it is rejected, lead very
" strongly to the belief that the stomach is the seat of organic
" change : on the other hand, her age, which is but 25 years,
" is much below that at which schirrous disease of the stomach
" usually comes on. The character of the vomiting, which is
" frequently decidedly bilious, is' not that which generally at-
" tends schirrous pylorus; in which disease, the matters ejected
" are often colourless in the early stages; and grumous, or
" coffee-coloured, in the last stages. Then again, the fulness
" over the region of the stomach and liver is greater, and more
" extensive, than is usual in schirrous pylorus, unless the sub-
" stance of the stomach be itself involved in the disease. At
" all events, her countenance denotes plainly visceral organic
" disease; and her emaciated and weakened frame forbid any
" but the mildest remedies, or the most gentle administration
" of the more powerful ones. Speaking to you, as I do, in
" doubt respecting this case, I could wish each of you to weigh
" the arguments on both sides. The disease may be in the
" stomach, or it may be external to it. It may be in the liver;
" or it may be in the omentum, and the peritoneal covering of
" the stomach and intestines. It is not unlikely that some
" extensive and complicated disease of these parts will be
" found after death."

In the following case, the same great difficulty of going
beyond a conjectural diagnosis will be recognised : still, the
symptoms are such as connect themselves in a most interest-
ing manner with the appearances after death, and seem to
offer much encouragement to our researches into the distinc-
tive marks of disease.

Case 9.

Sloughing Abscess of the Spleen.

Anne Howell, aged 21, was admitted, under my care, January
24, 1829, into Dorcas Ward. She was a housemaid; and was
in a most reduced condition, having been ill for some weeks ;
during which she had been very actively treated by copious
and repeated bleedings, for what had been considered an
attack of carditis, coming on immediately after having

undergone excessive fatigue by walking upwards of twenty miles.

Her chief symptoms after admission were, great depression, a rapid weak pulsation of the heart, and frequent vomiting; under which she sunk in about ten days, her legs having become œdematous.

SECTIO CADAVERIS.—The body not greatly emaciated: the right leg and thigh very œdematous: superficial veins, large, and turgid.

Pleuræ and lungs generally healthy, but exsanguine: some slight adhesion, and some more recent, from the diaphragm to the base of the left lung. The pericardium contained some ounces of straw-coloured serum, with thin tender films. The heart quite healthy: the blood partially coagulated, deficient in red particles.

In the abdomen, there were some cellular adhesions, of long standing, between the liver and the diaphragm, and between the liver and the stomach: on the left side were more recent adhesions in the neighbourhood of the spleen, circumscribing a cavity bounded above by the under surface of the left lobe of the liver, to the inner side by the stomach, and to the outer side by the spleen. This cavity contained an offensive dark-coloured matter, with a strong gangrenous odour; which was produced by the breaking down of a portion of the spleen, extending to no great depth into the organ, the remainder of which was firmer than natural, and of a red colour. There was a small circular aperture in the cardiac extremity of the stomach; but a portion of lymph prevented the gangrenous matter from entering. The alimentary canal healthy, but much contracted in many parts. Liver very exsanguine: healthy, except where a part assisted to form the parietes of the gangrenous cavity, and here it was covered with a thick loose false membrane. Kidneys and uterus healthy.

The common iliac veins, and the femoral, so far as traced, were filled with firm coagula, almost entirely of a yellowish-white colour, with some puriform fluid. Similar coagula, but accompanied by a larger proportion of puriform fluid, filled the inferior cava to within a short distance of that part where it receives the blood from the liver. As it approached this

part, the coagula became considerably contracted ; and above this part there was no coagulum.

The lumbar absorbent glands were somewhat enlarged, and of a light-red colour.

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In these two cases, we perceive a coincidence in the depressing influence exerted on the circulating, and perhaps more particularly the venous system, as shewn by the condition of the extremities in both : but as both patients were in a very exhausted state, we are not allowed to lay too much stress upon this fact, though I shall presently have occasion to mention a third corresponding case.

CASE 10.

Jaundice from general Enlargement of the Liver. — Spleen greatly enlarged, and studded with small hard opake bodies. The glandular and absorbent system much diseased.

JOSEPH PARKER was admitted into Guy's Hospital, under my care, December 20th, 1830. His chief complaint was, the enlargement of his abdomen, which was very considerable. A hard tumor occupied all the upper part of the abdomen ; and its edge might be traced distinctly almost into the pelvis. His countenance was a little sallow, and his eyes slightly tinged with bile. He had a troublesome cough, particularly at night, which sometimes went on to produce sickness. It appeared, that three years before he had been first attacked with pain about two inches below the false ribs, on the right side ; and since that time had never been perfectly well, though able to pursue his occupation, as a shoemaker, for some time. About eighteen months afterwards he went into the country ; and it was then that he first perceived his abdomen to enlarge. He suffered no pain ; but it increased so much, that seven months ago he was obliged to give up his work, and, in September 1830, went into the Mary-le-Bonne Infirmary ; where he was under the care of Dr. Hooper for eleven weeks, and left that institution a week only before his admission into Guy's.

The remedies which I prescribed, during the time he was under my care, were, light bitters, with taraxacum, and small

doses of blue pill from time to time: in addition to which, I applied the emplastrum ammoniaci cum hydrargyro to the tumor, and afterwards rubbed in the liniment of tartar emetic. Many little changes took place: the urine was occasionally more or less tinged with bile: the stools were sometimes of a drab colour: his cough often required palliative remedies; and the middle of February he experienced frequent epistaxis. His jaundice never exceeded the slightest yellow tinge; and he continued able to walk about the ward, when, in the end of February, he left the hospital on account of some domestic losses.—I saw nothing of him till June, when he was admitted into Guy's, under Dr. Back. He was now most dreadfully emaciated: the jaundice was much increased; and all along under his jaw was a row of enlarged glands of the size of small plums of an oval form, and only of a moderately hard consistence. His cough was very frequent, and he was completely confined to his bed. Serous effusion had taken place into the peritoneal cavity; which, while it rendered the abdomen larger, prevented us from feeling the tumor quite so distinctly as before. His cough was very troublesome: his tongue was red and glossy: his appetite bad, and his bowels relaxed. He had frequent vomiting of frothy bilious matter; and on the 21st of July he sunk.

SECTIO CADAVERIS.—The body was decidedly jaundiced, of a dingy yellow colour, and greatly emaciated. The right lung was hepatized, partly from old and partly from more recent inflammation. The liver was greatly enlarged, weighing above eleven pounds. It was flat and smooth on its surface, of an olive-brown colour; and, when cut into, shewed a general disease of the acini, which had a tendency to form clusters and masses, resembling, when divided, the cut ends of bundles of muscular fibres. The gall-bladder contained about an ounce of watery mucus, slightly tinged with bile. The kidneys were large: the spleen was at least six times the natural size, rather solid, and pretty thickly studded with very small light bodies, apparently thickened portions of cellular membrane. The whole of the lumbar glands were greatly enlarged, of a fleshy consistence, and homogeneous in their structure; with nothing of the fungoid structure, and nothing of the scrofulous appearance. Some of

them were red, with ecchymosis in their structure; but the greater part were of a flesh colour, with a yellow tinge.—The thoracic duct was very large; and was filled with blood, forming a dark soft coagulum.

The consolidated and granular condition of the spleen, which occurred in this case, is, I believe, the result of chronic inflammation; but sometimes an appearance not unlike this is produced by the early deposit of miliary tubercles,

Case 11.

Spleen reduced nearly to a Fluid State, connected with extensive Disease of the Absorbent Glands.

A WOMAN was admitted into Martha's Ward, under the surgeon, May 17, 1825, having been long subject to glandular swelling of the neck, and a chronic enlargement of the left mamma. She died after being in the house some time, from erysipelas attacking the neck and the neighbouring parts.

SECTIO CADAVERIS.—The glands of the neck and axillæ, and a set of glands occupying the situation of the thymus gland under the sternum, were greatly enlarged, as also the glands accompanying the trachea and bronchi, which formed almost a solid mass: the thyroid gland was hard.

The pleura had evidently been subject to recent inflammatory action: much serum had been effused: and the lungs were covered over, and their lobes stuck together, by a thin coating of lymph; but there was not the least tubercular tendency in any part of the lungs or pleura. About two ounces and a half of clear but high-coloured serum in the pericardium.

The abdomen presented considerable evidence of recent inflammation. Vascularity, turbid serum, and shreds of lymph adhering to the peritoneum. The kidneys very remarkable for size, quite healthy in structure. Liver very large, and pale-coloured; it descended below the umbilicus: gall-bladder large. The spleen was twice its natural size: the moment its tunic was broken into, the light-coloured grumous contents flowed out, almost like a creamy fluid. Pancreas healthy: mesenteric glands, many of them, enlarged, and of dark colour.

The peculiarly soft condition of the spleen, which presented itself in this case, is by no means unfrequent, in a less degree, in acute diseases: it has been particularly remarked as occurring in fevers. In the present case, it was probably to be ascribed to some extension of the inflammatory action which had been lighted up so generally in both cavities of the body, and which was more particularly determined to the spleen from the pre-existing condition of the absorbent glands.

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CASE 12.

Tuberculated Spleen, in a Case where the Tubercular Diathesis greatly affected the Glands.
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JOHN SHEPHERD, aged fifteen months, was affected with the cough, dyspnœa, and quick pulse, which usually accompany protracted inflammatory disease of the lungs in children. He was of an unhealthy aspect, with purple suffusion of the countenance; but not greatly emaciated, even shortly before death.

SECTIO CADAVERIS.—The lungs studded with cheesy tubercles. The bronchial glands were very much enlarged: one at the bifurcation of the bronchi was as large as a pigeon's egg, of a cheesy matter throughout: one higher up, of nearly equal size, was converted into yellow cheesy matter throughout half its extent. Tubercles were discovered in the peritoneum of the liver, and on the lower surface of the diaphragm towards the left side. The spleen was closely covered with omentum, which adhered to it. The spleen itself was tuberculated throughout. The mucous membrane of the intestines presented many small ulcers, resulting from tubercular deposits. The mesenteric glands were greatly enlarged.

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CASE 13.

Tubercles in the Spleen, in a Case of Phthisis, where the Glands were greatly affected.
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PATRIC HAMILTON, aged 30, was admitted into Guy's Hospital, under my care, June 13, 1827, in a perfectly hopeless state of phthisis. He was pale, and greatly emaciated: he had a troublesome cough, with expectoration and diarrhœa; and the absorbent glands of the neck formed soft and large tumors. He died on the 20th of the same month.

SECTIO CADAVERIS.—Much of the structure of both lungs was still crepitant, but thickly sprinkled with miliary tubercles: other portions were more consolidated, and also sprinkled with miliary tubercles. The peritoneum had, in various parts, formed strong and extensive adhesions. The adventitious matter forming the union was thickly sprinkled with collections of yellow scrofulous matter, most numerous where the adhesive matter was the thickest; but small tubercles were scattered on the peritoneal coat of the intestines, where no adhesion existed. There were some ulcerated tubercles on the mucous membrane of the intestines. The mesenteric glands were much enlarged, and going into a state of suppuration in their centres. The thoracic duct healthy, but small: the liver tolerably healthy, and the bile quite so. The spleen spleen was enlarged to four times its natural size, and indurated: there were a few small yellow tubercles in its substance. Kidneys healthy. The glands of the neck in a state of suppuration at their centres.

Case 14.

Tubercles in the Spleen, in a Case of Phthisis, where the Glands were greatly affected.

JULY 1826.—A native of Owyhee was admitted into Guy's Hospital with a large mass of suppurating glands in the right axilla, and symptoms of phthisis. He survived but a few days; when the absorbent glands of the axilla were found the seat of most extensive suppuration, which passed under the pectoral muscle, to the clavicle. The lungs were sprinkled with miliary tubercles, and the upper lobe of the right lung was in a more-advanced stage of disease.

The stomach and intestines tolerably healthy: the liver had one small tubercle on its surface; but on the spleen there were many, and several in the substance of that organ.

The mesenteric glands were much enlarged, forming masses the size of large walnuts; which, when cut into, were found to consist chiefly of soft tuberculous matter. The thoracic duct quite healthy.

F F

Case 15.

Tubercles in the Spleen, Lungs, and Liver.

A Black Man, admitted under the care of Dr. Cholmely, died with all the usual symptoms of phthisis.

sectio cadaveris.—The lungs were greatly diseased, particularly at their upper parts. Small tubercles were observed on the surface of the liver, as well as diffused throughout its substance.

The spleen was studded with rounded tubercles; most of which were softened in their centres, so as to leave little irregular cavities when a section was made. (See Plate III. Fig. 2.)

It is worthy of remark, that in three out of the only four cases of which I find the notes, where well-marked tubercles have appeared in the spleen of phthisical patients, the glandular system has been more than usually affected, in proportion to the disease of the lungs. In the fourth case, the state of the glands is not mentioned.

Case 16.

Suppurating Tubercles in the Spleen, in a Case of Fever, with Ulceration of the Mucous Membrane of the Intestines.

Jane Maulden, aged 18, was admitted into Guy's Hospital, Dec. 3, 1823, labouring under symptoms of fever, with severe bowel irritation and abdominal tenderness. She lay with her legs drawn up, to avoid pain; and was slightly delirious.

It appeared, that a fortnight before she had been attacked with cold chills, succeeded by heat, severe headache, pain in the limbs, pain in the right hypochondrium, and sickness. She had been twice bled, and had had a blister applied to her abdomen. The symptoms continued very severe, both as regarded the abdominal tenderness and the tendency to diarrhœa, and as regarded the unsteady and disturbed condition of the sensorium; and although, at one time, there appeared to be, for a short time, a decided amendment, yet erysipelas coming on upon the neck, she sunk on the 17th of December.

sectio cadaveris.—Surface of the dura mater and pia mater

very moist, from serous effusion : a small quantity of effused serum in the ventricles : substance of brain, firm ; when sliced, exhibiting very florid bloody points. Extensive but old adhesions of the pleura on the right side; and the same on the left, only to less extent : lungs collapsed, but not dis-organized : the blood they contained very florid. The liver pallid, and extremely firm and hard in its texture, containing but little blood, which was florid.

The spleen contained two scrofulous-looking tubercles; one in a state of suppuration, and only prevented from opening into the abdomen by adhesion which it had formed to the omentum ; the other was in a state of softening, not having gone to suppuration.

The general surface of the peritoneum and intestines healthy; only here and there exhibiting a florid appearance, and in some parts a green livid hue. The mucous membrane of the lower part of the ileum was in a high state of vascularity, and beset with ulcers of different sizes, which extended to the valve of the colon. Green feculent matter in different parts of the bowels. The jejunum and upper portion of the ileum perfectly healthy.

Case 17.

Tuberculated Spleen in a Case of Fever.

In the year ——, a young man died in Guy's Hospital with symptoms of fever. He had no appearance of tubercular disease about him; but, on examining his body, the spleen was found much enlarged, and studded with tubercular bodies, each composed of two or three deposits, so as to give the appearance of occupying several cells of the spleen : they were solid, and not undergoing any process of softening. Of this I made a section; and procured a drawing, a part of which is represented in Plate III. Fig. 1.

It is somewhat remarkable, that both these last were cases of fever, and were unaccompanied by symptoms of phthisis.

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The four following cases shew the spleen attacked by MALIGNANT DISEASE. The first two are instances of a some-what peculiar form of that malady, to which, I referred

in a former part of this Paper; and they are certainly very interesting, as forming a part of the series of splenic diseases.—The next is a case of the scirrhous form of malignant disease, developing itself precisely in the same manner in the spleen as it so often does in the liver.—The fourth is a case of the cerebriform cancer; shewing that the spleen, like the other organs of the body, occasionally becomes the seat of its destructive growth. Of the hæmatoid fungus I do not remember to have met with an instance in the spleen, but I see no reason to doubt its occurrence : and that melanosis pervades this organ occasionally, we have a proof in the very interesting case published, in 1826, by Mr. Fawdington, of Manchester; as likewise in the preparation at Fort Pitt, to which I have already alluded.

Case 18.

Spleen pervaded by Malignant Matter. The Absorbent Glands very extensively affected.

Ellenborough King, aged ten, was admitted, under my care, into Guy's Hospital, in 1828 : the youngest of six children; the rest all reported healthy. He likewise had been considered healthy till thirteen months ago, when his strength, flesh, and healthy appearance, began to fail. A tumor was observed in the left hypochondrium, in the situation of the spleen: the glandulæ concatenatæ on the right side were observed to be enlarged; but, by the treatment then employed, the tumors in the neck, and also the spleen, were, at times, considerably reduced. It does not appear that he was ever subject to hæmorrhage; nor, till very lately, to dropsical effusion. His appetite generally good.

After his admission, the tumor on the left side was observed to extend considerably below the left hypochondrium, but was reported to be less than formerly. The glands on the left side of the neck were swollen, as well as those on the right. The abdomen was somewhat distended, and the scrotum œdematous. His complexion was pale and wax-like. He survived several weeks, but no efforts could sustain his powers.

SECTIO CADAVERIS.—The head was not opened. The glands

of the neck had assumed the form of smooth ovoid masses, connected together by loose cellular membrane. When cut into, they were formed of almost a cartilaginous consistence, of light colour, slightly vascular, but with no appearance of softening or suppuration. Glands, similarly affected, accompanied the vessels into the chest; where the bronchial and mediastinal glands were in the same state, and greatly enlarged: some old pleuritic adhesions: lungs generally healthy: pericardium and heart healthy, but a slight serous effusion into the pericardium. In the peritoneum, considerable quantity of clear straw-coloured serum. Mucous membrane of stomach, and intestines, healthy. The mesenteric glands slightly enlarged throughout, and but slightly indurated; but those accompanying the splenic artery, the aorta, and the iliacs, were in the same state as the glands of the neck. The liver contained no tubercles, and its structure quite healthy. The pancreas rather firm, and the glands along its upper side enlarged.

The spleen was enlarged to at least four times its natural size: its surface was mammillated, and its structure altered throughout. When a section was made, at least three-fourths was seen to consist of white opake matter, almost like tallow, pervading every part; and assuming irregular ovoid and spherical masses, very much as if tallow in a melted state had been injected into the cells of the spleen, and then cooled. The glands around the roots of the vessels were all enlarged, and hard. (Plate IV. Fig. 3.) .

<div align="center">CASE 19.</div>

*Spleen pervaded by Malignant Matter.   The Absorbent Glands
very extensively affected.*

JOSEPH SINNOT, aged 9, was admitted into Guy's Hospital, 18th of Oct. 1826, under the care of Mr. Morgan, on account of a large ulcer on the scrotum, occasioned by a puncture, made with a view to evacuate serum from the cellular membrane. It was stated, that he had always slept with his brother, who, a few months before, died of phthisis. He was much reduced by an illness of about nine months; during which he had been subject to a pain in the back, extending round to

the abdomen.   On his admission, his belly was much distended with ascites : he had also effusion into the prepuce and scrotum.   He died on the 26th of November.

SECTIO CADAVERIS.—There was no remarkable appearance in the head.   Slight adhesion, and a little effusion into the cavities of the pleura.   Slight trace of tubercular cicatrix at the apex of the right lung, and a very few exceedingly small tubercles scattered through the lungs.   Bronchial membrane vascular.   Bronchial glands greatly enlarged, and much indurated.   Heart healthy.

Extensive recent inflammation of peritoneum, with copious scrofulous effusion.   Intestines tolerably healthy.   Mesenteric glands generally enlarged, but one or two equalled the size of a pigeon's egg, of semi-cartilaginous hardness, and streaked with black matter.   The substance of the liver generally natural; but a few tubercles somewhat larger than peas, which were semi-cartilaginous, and of uneven surface. The pancreas contained numerous very hard and rounded tubercles, particularly towards its head, which was much enlarged.

The spleen was large; and contained numerous white bodies of irregular ovoid shape, precisely similar to those mentioned in the last case; but not so numerous, the disease not being so far advanced.   The absorbent glands about both the two last-mentioned organs were much enlarged.

Both kidneys were mottled, but not indurated.   A continuous string of much-enlarged indurated absorbent glands, of a light colour, accompanied the aorta throughout its course, closely adhering to the vertebræ, and extending along the iliac vessels, as far as traced into the pelvis.   Thoracic duct healthy.

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CASE 20.

Malignant Disease of the Scirrhous Character affecting the Spleen, together with many other Organs of the Body.

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JOHN FENN, aged 30, was admitted into Guy's Hospital, under the care of Dr. Cholmely, with rheumatic pains, quickly followed by paraplegia; under the aggravated circumstances of which he sunk, in about eight weeks.

SECTIO CADAVERIS.—A malignant tumor was found arising from the ligaments of the spinal canal in its dorsal portion, and pressing on the dura-matral covering of the spinal cord. The substance of the sternum contained a fungoid tumor; and the same disease was found in one of the ribs, the pleura costalis, the lungs, the inner surface of the pericardium, the bronchial glands, and the axillary glands. In the substance of the liver were several whitish-red tubera, one large one in the spleen (Plate III. Fig. 3.), one in the kidney, and one attached to the pelvis. Several small tubera under the pericranium, and one between the bone and the dura mater.

CASE 21.

Malignant Disease of the Cerebriform Character, affecting the Spleen in common with other Organs.

ANNE BURFORD, aged about 35, was admitted, under Dr. Back, on the 10th of June 1829. She had for some time laboured under an affection of the abdomen; and a hard tumor was felt, attributed to fungoid growth of the omentum. During her illness, she appeared repeatedly to suffer from attacks of subacute peritonitis. She became greatly emaciated; and occasionally troubled with diarrhœa, and latterly with vomiting. The case was evidently hopeless; and she sunk on the 13th of the following month.

SECTIO CADAVERIS.—The chest healthy. The viscera of the abdomen were matted together by thick peritoneal adhesions, intermixed with tubera of various sizes, composed of cerebriform matter. The omentum was converted into a thick mass of fungoid tumors. There were similar growths in various parts; and, amongst the rest, some which had made their way towards the intestines, on the mucous membrane of which they had ulcerated. One, of the size of an egg, was situated in the small omentum. There were two pretty large and soft tubera, of the same description, imbedded in the under surface of the liver; and a few small tubera, of a similar kind, on the convex surface of the liver. The structure of the organ was pretty healthy, but pale. One, of the size of a pigeon's egg, was imbedded in the spleen, on its convex side. There were one or two small ones on the pancreas, which was in other

respects healthy. Similar tubera existed in the mesenteric and lumbar glands. The kidneys were healthy. The whole of the true pelvis was filled, and the viscera matted together, by similar cerebriform tubera.

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How far we are authorized in considering the two following cases in any other light than as affording accidental deviations from the healthy state of the spleen, is doubtful : but though this may be assumed with respect to the cellular cysts, yet, in the case where bony deposit had taken place, there was evidence of a peculiar action being set up in the vessels : and it is singular, in connection with observations which I have frequently had occasion to make, that the same morbid action existed also in the vessels of the mesenteric gland, some of which were likewise ossified; thus supplying us with the third coincidence of this kind ;—for already we have seen the tubercular action occurring at the same time in the spleen and the absorbent glands, and, also, the malignant action developed together in these two situations.

CASE 22.

Bony Deposit in the Spleen and Mesenteric Glands.

MARIA COCKERELL, aged 45, was admitted December 22, 1825, labouring under anasarca, with feeble and obstructed circulation, great difficulty of breathing, frequent cough, and mucopurulent expectoration tinged with blood. She died on the 23d of January.

SECTIO CADAVERIS.—The form of the chest greatly contracted. Lungs universally adhering to the pleura, and gorged with blood: no tubercles. Heart natural : the pericardium contained four ounces and a half of straw-coloured serum. Kidneys healthy : liver pale coloured: spleen very small, with two small pieces of bony matter imbedded in its substance (Pl. V. Fig. 1). Mesenteric glands rather large: one or two ossified.

CASE 23.

Cysts in the Cellular Membrane of the Spleen.

CHARLES BUCKINGHAM, aged 45, was admitted into Job's Ward, 23d of June, 1830, affected with general dropsy, ascites, ana-

sarca, and effusion into the chest. He sunk about three weeks after his admission, with symptoms resembling apoplexy.

SECTIO CADAVERIS.—Considerable serous effusion was found beneath the arachnoid : the right pleura contained above three pints of clear serum, intermixed with tender flakes : the left pleura adhered very generally : the lungs were sprinkled with tubercles : the pericardium adhered universally by a perfectly-formed cellular membrane: slight disease in the aortic valves, and the aorta : peritoneum universally covered with a thin false membrane: the cavity of the abdomen contained a considerable quantity of serum: the liver tolerably healthy.

The spleen was swollen and tuberose at the upper extremity, and evidently contained a fluid : this was found to be in cysts, some of which did, and some did not, communicate (Plate V. Fig. 2): they were smooth internally, but yet presented a reticulated appearance: they were quite distinct from the peritoneum, but lay just beneath it. Kidneys slightly mottled. Urine in the bladder albuminous.

The following cases will illustrate some of the changes which take place in connection with the PERITONEUM of the spleen. It is true that these changes are, in general, such as befal the peritoneum generally; but they must have considerable influence in embarrassing the functions of the spleen; and, according to circumstances, may well be expected, either to prevent the ingress of blood when required, or, by opposing the contractile force of the elastic tumor, to prevent the organ from unloading itself, and thus favour its disorganization.

I do not think it necessary to give cases to shew the existence of cartilaginous deposits on the spleen: the instances are very numerous; and I shall satisfy myself with transcribing a few of the statements I have made in various dissections.

"The spleen small, and its external surface rough, with slight cartilaginous deposits."

" The spleen with many small cartilaginous deposits, in spots, upon its surface."

" The spleen, which was very soft and small, had, besides the adhesion before mentioned, numerous small cartilaginous bodies on its surface."

" The spleen afforded a marked illustration of the mode in which the cartilage is often distributed in little lumps or granules on its surface."

" The spleen was soft and light-coloured: a large patch of cartilage was deposited on its surface."

" The spleen healthy, but surrounded by fat; and a patch of cartilaginous substance occupied a part of its surface."

" The spleen four times its natural size: its peritoneum coated with a thin pellicle of recent coagulum; and under that, about half its convex surface covered with a semi-cartilaginous substance."

" The spleen rather soft, with semi-cartilaginous patches."

In other cases, the whole spleen is covered in this way with a cartilaginous coating. A fine specimen of this kind is preserved in our Museum, having a worm-eaten appearance on its surface, from the irregular deposit, but deficient in no part of the spleen: and two portions of spleens, similarly invested, are preserved in the interesting Collection of Dr. Baillie, in the Museum of the Royal College of Physicians.

The cases from which these were taken, varied much: they were cases of epilepsy, apoplexy, dropsy, &c. I may mention, however, that in a considerable majority, though not in all, the large arteries of the body were stated to have been diseased, having atheromatous deposits in their tunics.

I have said, that, occasionally, plates of bone are formed in the cartilaginous deposits on the surface of the spleen. To a small extent, this is not unfrequent; but sometimes the whole spleen is found invested with bone: of this I have seen a very fine specimen in the magnificent Collection of the Royal College of Surgeons. A spleen of about twice the natural size is covered completely by a thick scabrous coat of bony

hardness, presenting small rounded projections of nearly a quarter of an inch in height, over its whole surface.

CASE 24.

Peculiar Appearance of the Peritoneal Coat of the Spleen.

JOHN BALLS, aged 32, a sailor, was brought to Guy's Hospital, Nov. 24, labouring under most excessive hæmatemesis, which occurred again, with great severity, on the 26th and 27th. He experienced convulsive fits; and fell into a lethargic state, in which he died.

SECTIO CADAVERIS.—Heart and lungs healthy: liver and mucous membrane of stomach and intestines very exsanguine.

The spleen presented a very peculiar appearance: it was covered with a thick, tough, almost cartilaginous membrane, which lay upon it in deep irregular folds. It was evident that the spleen had been greatly distended; and at that time the false membrane had covered it, and doubtless embraced it firmly; but now, by the excessive loss of blood, the spleen had contracted. The covering had not sufficient elasticity to contract with it, and lay folded up upon its surface. The colour of the spleen, internally, was very pale. The splenic vein very large.

The brain was remarkably exsanguine. There was a mass of the size of a large pea, like the pineal gland, attached to the plexus, in the posterior cornu of one ventricle.

In this case, as far as we could discover, the hæmatemesis depended on the spleen; and, in all probability, was owing rather to the state of the peritoneal covering, than of the organ itself.

CASE 25.

Tubercular Deposit on the Peritoneum of the Spleen.

MARY PEACOCK, aged 14, who was admitted, under my care, with general peritoneal inflammation of a chronic character, died after lingering about two months.

The most extensive adhesions were found, with large quantities of tuberculous matter, in various parts. These, upon the surface of the spleen, formed a mass of nearly a

quarter of an inch thick over the whole convex surface. The lungs were but partially sprinkled with tubercles in this case; but the bronchial and other glands were much enlarged, and in a state of scrofulous disease.

CASE 26.

Spleen, with the Peritoneal Covering studded with flat Scirrhous Growths.

JOHN WALKER, aged 62, was admitted into Guy's Hospital, Feb. 2, 1833.

In this case, the true scirrhous tubera had developed themselves extensively in the liver and over the whole peritoneum; and the peritoneum covering the spleen was also involved in the disease. Throughout the whole of this membrane, the tubera presented somewhat the same aspect. They were scarcely raised above the surface, and assumed a somewhat circular form, with broken edges, looking by no means unlike drops of tallow let fall into water: some were very superficial; others were of the thickness of a shilling.

As the symptoms and progress of this case presented nothing peculiar, in connection with the affection of the spleen, it will be unnecessary to go further into its details.

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LACERATION OF THE SPLEEN.

The spleen, although protected more than almost any viscus of the abdomen, is liable to be injured from external violence; and not unfrequently death is the result: for though it has been proved, that various animals, and even man, can exist, and apparently do well, when the spleen has been partially cut away or has been entirely removed, yet the irritation and inflammation produced by lacerating its substance will, of course, give rise to effects which may destroy life. But the most common way in which this accident proves fatal is in consequence of the hæmorrhage which takes place into the abdominal cavity. When this is very extensive, death is produced by the mere loss of blood: when less extensive, the peritoneal inflammation consequent upon the injury of the organ and the effused blood destroys life in

a very limited time: and when the quantity of blood which escapes into the cavity is small, there is every reason to believe, that, by the united efforts of organization and absorption, the extravasated blood may be so disposed of, as to become comparatively innocuous. But there is a still less extent of injury to which the spleen is frequently subjected. In this case, the substance of the spleen only is ruptured, and the blood is retained by the tunic and the peritoneum; by which means a clot is formed, filling up the internal fissure; and from this the red particles gradually disappear, as from an apoplectic clot in the brain, leaving, at last, a yellow mass, which interferes very little, if at all, with the functions of the organ, and is only detected by the peculiar appearance it presents when death takes place from some other cause. (Plate IV.)

In the First Volume of my Medical Reports, I mentioned two cases of persons who had died of other diseases, but in whom this appearance was casually found; and it is from the drawings made from them that Fig. 1, and Fig. 2, Plate IV. are taken. In one of these cases, I have stated, that "the spleen, in general pretty natural, had a peculiar appearance in one part, as if, blood having been effused, the red particles had been absorbed, and the coagulum had afterwards become imperfectly organized." But I perceive that Dr. Hodgkin, in his valuable Notes to the Catalogue of Guy's Museum, speaks of this appearance as being "a circumscribed degeneration of the structure of the spleen, which becomes preternaturally firm and dense, and of a light colour;" which, he afterwards says, he is inclined to think the effect of external injury. I think, however, that the view I had taken of these peculiar hard yellow-white masses, as being truly altered clots of blood, is probably the more correct; and a preparation in our Museum, where a partial rupture of the kind to which I have referred had taken place in the spleen of a child over whom a cart had passed, and who sunk from the complicated and severe injury she sustained, after surviving nearly three days, seems so much in point, that I will give the case from which it was taken.

Case 27.
Laceration of the Spleen.

ANN FLEUKER, aged 9, was admitted into Guy's Hospital, under Mr. Morgan, on the 8th of November 1826, in consequence of having been run over the day before; a cart-wheel passing over her body so as to produce fracture of the bones of the pelvis, with great general mischief and contusion. She survived till the following day, having lived nearly three days after the accident.

In addition to all the other mischief, it was found that the spleen had been lacerated, and enough blood had escaped into the cavity of the abdomen to colour the intestines: but there had been no overwhelming hæmorrhage; for it appeared, that though the substance of the spleen had been almost divided through its centre, the peritoneum had retained the blood, so as to form a clot nearly an inch thick across the centre of the spleen, resembling, very exactly, the clot represented in Plate IV. Fig. 1; only that, in this case, the clot, instead of being a yellow substance, was the recent coagulum of blood.

This case, then, seems to present the first stage of that yellow mass which is often found in the spleen; and, under certain circumstances, it is probable that the semi-organized coagulum becomes the seat of abscess; at least such appeared to be the fact in the following case, for further particulars of which I must refer to the Second Volume of Medical Reports, p. 168.

Case 28.
Abscess in the Fibrin left after the Extravasation of Blood in the Spleen.

MARIA LARTHEN, aged 17, was admitted into Guy's Hospital, Oct. 22, 1829, in an exhausted state: countenance pale and anxious: her eyes sunk: exquisite tenderness to the touch generally: feet and legs slightly œdematous: ecchymosed spots upon the hands and feet: a large abscess in the axilla, and another on the fore-arm: abdomen tumid, as well as tender: pulse 152: respiration 44, short, difficult, and painful: tongue dry, with a broken fur: much sordes about the mouth and teeth: during last week, some epistaxis, and blood in the motions. It appeared that she had been for some

time in a declining state of health; but the immediate cause of the external symptoms was supposed to be a prick with a needle, on the fore-finger, five weeks previously. She died on the following day, under symptoms of great cerebral disturbance, vesication having taken place upon the toes and upon the fore-arm and hand, containing a bloody serous fluid.

sectio cadaveris.—There were most unequivocal proofs of very severe recent inflammation of the peritoneum and of the pleura, particularly on the left side, and softening of the brain. But that part of the examination which is more particularly interesting at present, is, that the spleen was the seat of extensive disease; appearing to have suffered first by some fibrinous deposit, which was so extensive as to occupy nearly one-third of the whole spleen, the greater part deposited about the centre of the organ, nearly crossing its short diameter; and this deposit had lately run into a state of unhealthy suppuration, so that it formed an imperfect abscess; and another smaller deposit of the same kind had undergone a similar change. The arteries and the veins of the whole body were perfectly healthy.

Independently of this case serving to shew another step in the progress of this affection, it is interesting, in connection with two other cases of abscess of the spleen already related; in both of which, the powers of the circulation had been greatly reduced, leading, in one case, to gangrene of one of the extremities, as had been distinctly threatened in this.

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When we review the cases, which I have selected as forming a fair example of those which occur in practice where the spleen is implicated, we perceive, that, in the great majority, that organ merely partakes with others in some general state of derangement, and does not itself become a separate object of treatment. In other cases, the changes in structure are so apparently casual, as neither to be capable of detection, nor, if detected, to admit of any remedial measures. Of the few which remain, the principal diseased conditions are, the congested state of the organ, its consolidation, its inflammation, and its laceration from external violence.

On the treatment of each of these conditions I would now make a few remarks, did I not feel that this communication had already reached to such a length, that it would be right to draw it to a conclusion: but I may observe generally, in reference to splenic disease, that it is probable that the spleen is greatly influenced by the derangement of many of the other organs of the body; and therefore its treatment will often depend on the regulation of their functions: for we cannot doubt, that whatever acts decidedly on the circulating system, must, in some degree, influence the spleen; which obviously, from its structure and appearance, receives large quantities of blood, as subsidiary to the processes of sanguification or circulation. Still, however, it is by no means an organ easily susceptible of diseased action, and withstands the effects of injurious agencies to a very considerable extent. Probably the spleen sympathizes in a particular manner with the skin, suffering from suppressed perspiration and cold and damp applied to the surface. It also appears to be affected by certain states of atmosphere, which act as a poison upon the system, evinced particularly in countries subject to marshy exhalations. It also probably suffers from interruption in the functions of the hepatic, the renal, and the absorbent systems, as seen in the organic evidence of their diseases, and partakes of the irregular distribution of blood, caused by the diseases of the heart and arteries.

From reflecting on the frequent combinations of these and other morbid states with splenic disease, we perceive, more exactly, the mutual relations and unions existing between them; and this is always an interesting light in which to view disease. The chief points of approach or contact to which our attention is directed, are, the occasional intermixture of splenic disease with disease, more or less extensive and confirmed, of the absorbent system; the depressed state of circulation occurring in severe affections of the spleen; the coincidence of splenic with hepatic disease; its connection with derangements of the peritoneum; and some relation, though probably only collateral, between that state of the kidneys which produces albuminous urine and derangement of the spleen. By holding these and such like points

in our minds, we shall comprehend, more fully, the possible value of the knowledge to be derived from following out the history of the derangements of the spleen, than we should by simply considering the morbid states of an organ of which so little is known with certainty: for the enumeration of morbid conditions can, at best, only be viewed as forming an alphabet for the construction of a language, into which we may hereafter translate the complicated and obscure legends of disease.

PLATE I.

Presents three Diagrams, illustrating the gradual Diminution of the Spleen, in the case of Ellen Carter, affected with intermittent fever. (Case 1. p. 412.)
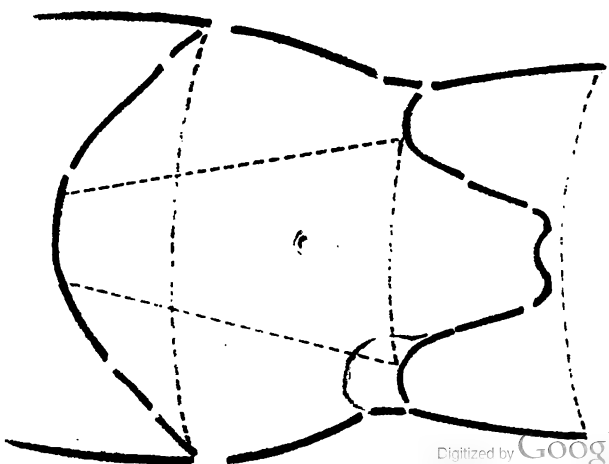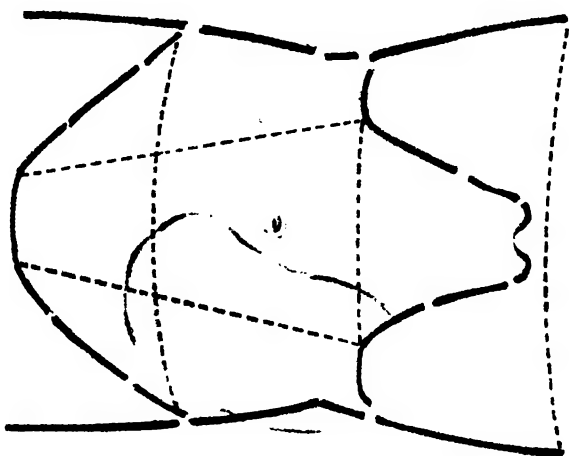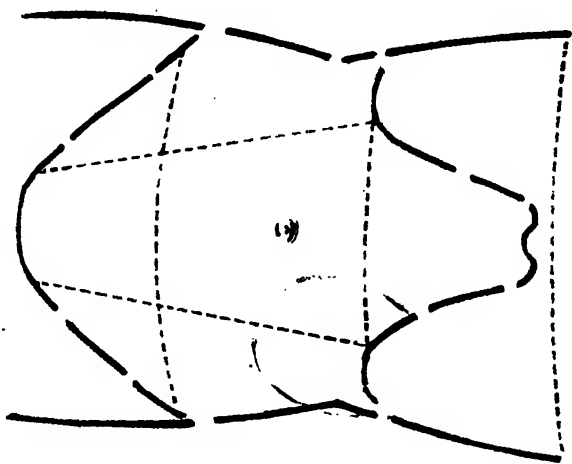
Fig. 1.
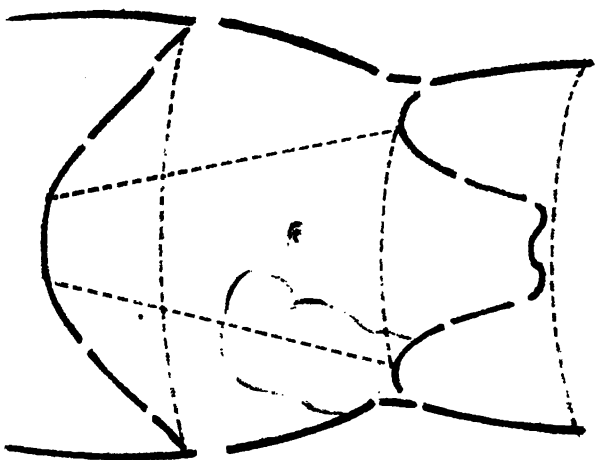
Fig. 2.
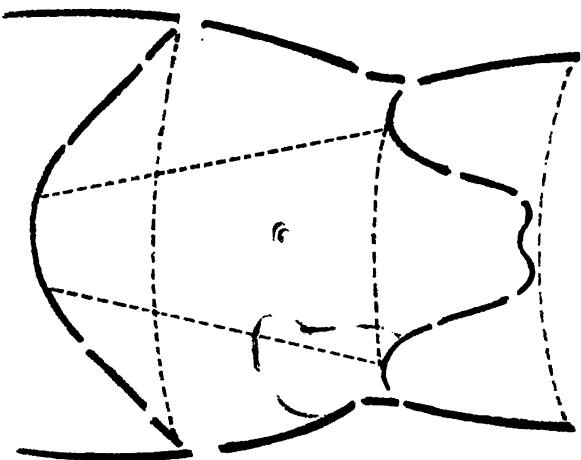
Fig. 3.

Fig. 1

Fig. 2

PLATE III.

Fig. 1. A portion of the section of an Enlarged Spleen, studded with Tubercles, in a case of fever, without other evidence of the tubercular diathesis.   (Case 17. p. 435.)

Fig. 2. A portion of the section of a Spleen studded with Softening Tubercles, in a case of general tubercular diathesis. (Case 15. p. 434.)

Fig. 3. A portion of the section of a Spleen containing a large Scirrhous Tubercle, in a case where many of the organs were affected with the same disease.   This drawing is reduced to about half the actual size.   (Case 20. p. 438.)
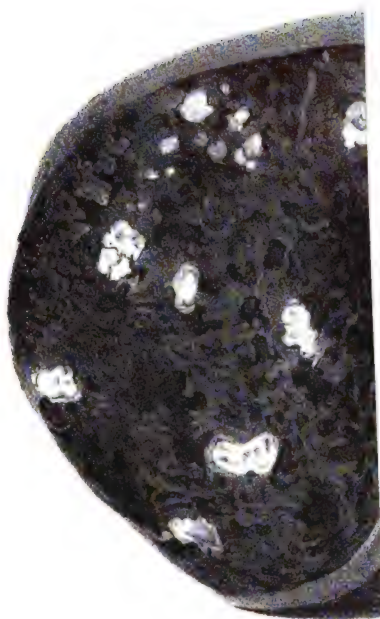
Plate III.

Fig. 1.

Fig 2

R. Say del.t

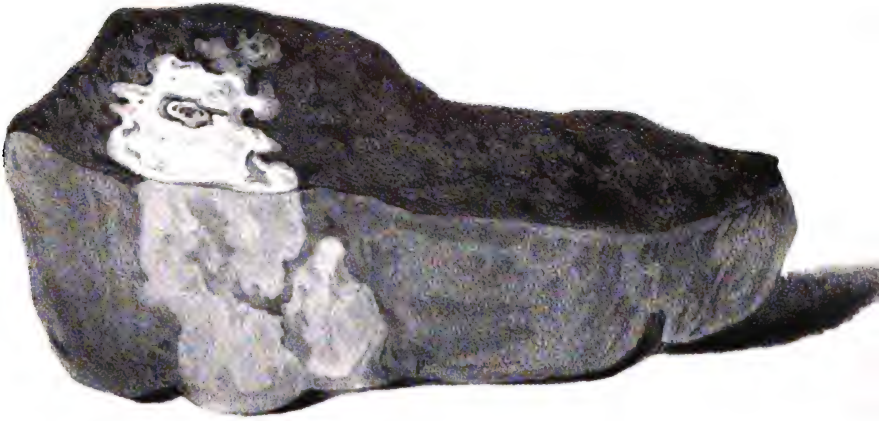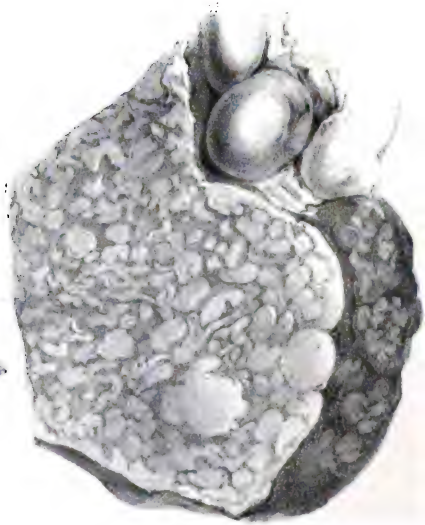Published by S Highley Fleet

Plate IV.

Fig. 1.

Fig. 2

Fig. 3.

PLATE V.

Fig. 1. Section of the Spleen, shewing two small deposits of bone in the substance of the organ. (p. 406.)

Fig. 2. Section of a small portion of the Spleen, with cysts developed in the cellular membrane. (p. 407.)
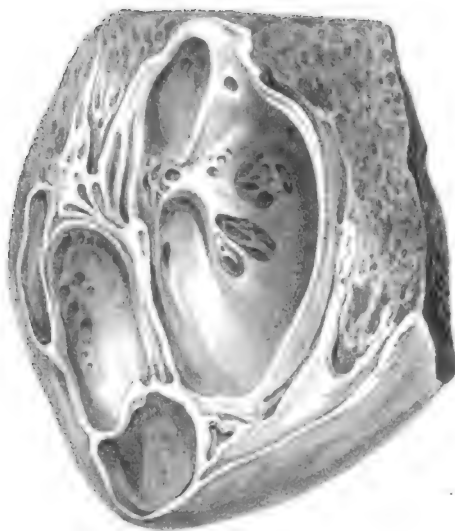
Plate V.

Fig 1.

Fig 2.

(**460**)

PLATE VI.

The Abdominal Tumor produced by an Enlarged Spleen.
(Case 5. p. 420).

PHYSIOLOGICAL OBSERVATIONS

ON THE

MUSCLES OF THE EYE.

BY BRANSBY B. COOPER, F.R.S.

WHEN we consider, anatomically, the muscles of the eye, we at once perceive the efficiency of the four straight ones, for giving to its axis every direction necessary for the admission of light. But, in the progress of dissection, two others are brought into view, which might at first appear superfluous: and certainly, when we recall to our minds the apparently perfect apparatus before alluded to, their functions do not readily suggest themselves.

It might be at first supposed they are for the purpose of giving a more various and complicated motion to the eye-ball than could be produced by the action of the other four. This, however, is difficult to imagine, when it is remembered that the recti muscles are fully competent to move the eye in every direction, either upwards, downwards, inwards, or outwards; and, by their combined actions, the pupil may be directed in any of the intermediate angles; or, by a succession of these actions, the eye may be made to revolve within the orbit.

We find, also, that the oblique muscles are evidently not fitted to assist in the action of the straight; for the fixed point, to which all their motions are directed, is at the forepart of the bony socket;—and, that they pass backwards to be inserted, so that their attachment to the globe of the eye forms a diagonal with the insertion of the recti muscles, which renders it impossible for them to assist in the other's action. They are therefore, on this account, to be considered as antagonizers, or, at any rate, as moderators to the influence of the recti.

These muscles, from the direction of their insertions, are termed the oblique; and their relation to the eye-ball has been so accurately described, that, in an anatomical point of view, they appear to be perfectly understood; but the uses for which they are employed, seems, nevertheless, yet involved in mystery.

It is my object, therefore, to attempt, by dissection and experiment, to throw some light upon the subject: for, upon investigating the published opinions of others, I am surprised to find how little has been done beyond the mere description of the attachment of each muscle of the eye, and their supposed individual influence, as conceived from the direction of their fibres; no author having sufficiently taken into consideration the effects which must be produced upon the globe of the eye by the combined influence of so many differently directing powers.

The anatomist might consider that there is little else left to be done, than merely to study the direction of each of the six muscles, and then mechanically to examine the effects produced by the contraction of their fibres upon the movements of the eye-ball; first observing the influence of each muscle separately; next, the combined action of two or more; and, ultimately, the influence of all.

Such a mode of procedure would be sufficient, if it were the fact, that all these muscles derived their nervous influence from the same source: but the reverse of this is found to be the case; namely, that they are supplied by different nerves, connected with different parts of the centre of the nervous system, and which excite their respective muscles to contract upon the application only of an appropriate stimulus; so that the motions of the eye must be considered obedient to all the modifications of their various influences, and not merely subjected to one source of muscular contraction.

Before, however, I enter into the consideration of this part of the subject, it is necessary briefly to describe the attachment of the muscles both to the bony orbits and to the ball of the eye.

The globe of the eye is placed within its bony socket, surrounded by a considerable quantity of fat, and by certain muscles; the latter of which are destined to give motion to the

eye, partly for the admission of light, partly, perhaps, for the modification of its influence upon the retina, and partly to protect the organ from external violence.

The muscles, then, which affect the various motions of the eye in the human subject are six in number; four of which are termed the *straight* muscles, and two the *oblique.*

The four straight are lengthened and flattened muscles, which arise at the posterior part of the orbit, from the optic foramen, where they surround the nerve; from thence they proceed forward meridionally, to be inserted into the globe anteriorly to its great diameter.

These muscles derive their names from their relative position to the eye-ball, as well as from the direction in which they are destined to draw the pupil.

Musculus rectus superior, vel *attollens oculi.*—This muscle arises from the upper edge of the foramen opticum; and passes forwards upon the upper surface of the globe of the eye, beyond the great diameter of the organ, where it has a tendinous insertion into the sclerotic coat. Upon contraction, it directs the pupil upwards towards the eyebrow, and draws the point of its insertion backwards into the orbit as far only as is permitted by the compressibility of the fat in the orbit.

Musculus rectus inferior, vel *depressens oculi*—arises from the lower part of the foramen opticum; and runs along the under surface of the eye-ball, to be inserted anteriorly to its great diameter. This muscle directs the pupil downwards towards the cheek; and so far antagonizes the former muscle, but, like it, assists in drawing the eye-ball backwards into the socket.

Musculus rectus internus vel *adductor oculi*—arises from the inner side of the optic foramen, passes along the nasal side of the globe, and is inserted into the sclerotic coat anteriorly to the great diameter of the eye: its use is, to direct the eye inwards towards the nose, as well as to draw the globe backwards.

Musculus externus vel *abductor oculi*—is placed on the temporal side of the orbit, arising from the outer side of the optic foramen; but is also peculiar from being attached, by a tendon, to the edge of the foramen lacerum orbitale superius, affording it a double origin: it then passes forward beyond the transverse axis of the globe, to be inserted into the sclerotic coat.

Its use is, to draw the pupil outwards towards the temple, to antagonize the action of the last muscle, and to assist in drawing the globe into the orbit.

Such is the description of the four straight muscles of the eye, as far as is necessary for the present object: from which it may be observed, that they all arise nearly from the same point at the back part of the orbit from whence they diverge, extending beyond the great circumference of the ball, to be inserted tendinous into the thinnest part of the sclerotic coat. When these muscles act together, they have a tendency not only to draw the whole of the eye backwards towards their point of origin, but, also, so to compress the globe as to increase its antero-posterior axis, and alter the position and density of the humours. When only two of the straight muscles act together, the pupil is moved in the direction of a line which divides the angle made by the directions of the two forces; as, for instance, when the rectus superior and internus muscles are in a state of contraction, the pupil is drawn upwards and inwards in the direction of a line between the two muscles.

But when the muscles of the eye and eyelid are inactive, and the eye closed, the pupil seems immediately to be involuntarily directed upwards and inwards, under the inner extremity of the eyebrow. This direction to the eye does not appear to be produced by the contraction of its muscles, but rather by the influence of the orbicularis palpebrarum, which induces the closing of the lids so soon as it ceases to be acted upon by its moderating muscles; and, at the same time, from its loose connection on the temporal side of the orbit, and its fixed attachment on the nasal, it necessarily presses the globe of the eye inwards and upwards.

The oblique muscles are more delicate and slender than the straight, neither are their fibres of so vivid a red colour. They differ also materially from the straight muscles, in the direction of their fibres; passing obliquely from before, backwards, to be inserted tendinous into the sclerotic coat, posteriorly to the great circumference of the globe.

Musculus obliquus superior vel *trochlearis*—is the longest and thinnest muscle of the eye: it arises from the inner edge of the foramen opticum; and runs along the internal wall of the

orbit between the rectus superior and internus muscle, towards the internal angular process of the frontal bone; before it reaches which, it becomes converted into a rounded tendon, and passes through a fibro-cartilaginous ring or trochlea which is attached to the fossa trochlearis of the frontal bone: the tendon becomes then directed backwards at a very acute angle, and, passing obliquely outwards, runs under the superior rectus muscle on the globe of the eye, into which it is inserted a little to the temporal side of its centre, about five lines from the posterior extremity of its axis.

The action of this muscle is to direct the pupil downwards and outwards, and to draw the globe of the eye forwards; thus antagonizing the recti.

Musculus obliquus inferior—is the shortest muscle of the eye: it arises from the infra-orbital margin of the superior maxillary bone, immediately behind the lachrymal canal, runs upon the bottom of the orbit under the inferior rectus muscle, and then becomes directed upwards and outwards to be inserted into the globe of the eye to the inner side of the rectus-externus muscle.   The use of this muscle is, to direct the pupil upwards and outwards, and to assist in drawing the globe forwards.   The opinions, however, which are given by different authors on the action of this muscle, vary, perhaps, more than in the description of the influence of any other muscle in the body: which circumstance may probably be attributed to a want of attention to the degree of contraction of the muscle during the period of examination; for it will be found in the dead subject, that if the inferior oblique be only slightly drawn towards its origin, the pupil will be directed upwards and outwards; but that if it be forcibly pulled, so as to equal its supposed most perfect contraction, the eye will be made to revolve on its own axis, and the pupil will become directed upwards and inwards;—an experiment which accounts, in my opinion, for the incongruity which is found in the published accounts of the influence of this muscle on the direction of the eye.   It is very difficult, if not totally impossible, to judge of the action of the oblique muscles, and the effect of their contraction upon the eye, in the living animal: although most authorities agree in the accounts they give of their influence upon the organ of vision, still none have

explained by what kind of experiment or observation they have arrived at their conclusions.

Albinus says, that the superior oblique causes the pupil to be directed downwards and outwards towards the promontory of the cheek.

Galen appears to have been ignorant of the origin of this muscle, as well as of the trochlea, through which its tendon passes, which was discovered, after his time, by Fallopius; so that he cannot have understood its proper action.   Poterfield and Kennedy say, that the superior oblique muscle directs the pupil downwards.   Sir C. Bell describes this muscle as directing the pupil downwards and outwards; although, at the same time, in speaking of the two oblique muscles, he considers them as involuntary, and capable of directing the eye upwards and inwards under the eyebrow, when the action of the four straight muscles is destroyed.   Hildebrand says, the action of the superior oblique muscle is, to turn the globe of the eye above forwards and inwards, so that the eye-sight is turned downwards and inwards.

Gataken says, when the superior oblique acts singly, it rolls the eye upon its axis, drawing the globe forwards, and turning the pupil downwards.

F. Muller says it draws the eye-ball upwards and inwards, and thus expresses sublimity.   Thus it may be seen that a considerable difference of opinion exists amongst these authors, and that the point is still open to investigation.   With respect to the action of this muscle upon the globe of the eye, as far as refers to experiment upon the dead subject, there can be no doubt, that, as this muscle does not act in the direction of its fibres, but in that of its tendon from the trochlea, which takes a course backwards and outwards, to be inserted into the upper and outer side of the globe, this point of insertion is rolled by the contraction of the belly of the muscle inwards and forwards, so as to direct the pupil downwards and outwards: but still, such an experiment does not prove that this muscle is the sole agent employed in the voluntary direction of the eye downwards and outwards; and there is, therefore, required some further investigation of the living action of these muscles, as depending upon the influence of the nerves.

The same incongruity of opinion exists in the account of the various authors, as to the use of the inferior oblique.

Albinus says, the inferior oblique muscle rotates the eye from the outer side along the floor of the orbit, and directs the pupil upwards towards the temple. Poterfield states, that it rolls the eye on its axis from the nose, drawing the globe forwards, and directing the pupil upwards. Kenneday says it draws the eye upwards and forwards. Sir C. Bell, that it draws the pupil upwards and inwards under the eye-lid. Meckel says it rolls the eye-ball upon its axis outwards, and brings it forwards, and directs the pupil downwards and inwards. Hildebrand says it directs the globe, so that the sight is directed upwards and inwards. Gataken says, that when the inferior oblique acts singly, it rolls the eye upon its axis, serving likewise to draw the globe forwards, and directing the pupil upwards. Mr. Dalrymple—in the accuracy of whose observations on any point, either of anatomy or physiology, I have the highest confidence—describes the use of the inferior oblique muscle in the following words:—"The action of the inferior oblique is, to roll the eye upwards and inwards under the superior eyelid." F. Muller says, that the inferior oblique muscle is the antagonist to the superior, rolling the globe so that the pupil is directed upwards and inwards.

By experiment on the dead subject, I find, as I have already stated, that it depends upon the degree of force employed, whether the pupil is directed to the outer or inner side of the orbit; but, in either case, upwards;—when the muscle is gently drawn, it is directed to the temporal side of the orbit; but when more violently, to the nasal side, the rotatory influence on the globe being increased. The rotatory motions of the eye on its own axis seem to be produced wholly by the action of the oblique muscles; and, at the same time, they so moderate the influence of the recti, as to keep the eye relatively fixed during the examination of an object, whether in motion or at rest.

I shall now describe the distribution of the nerves to the muscles of the eye, before I detail the results of my experiments of the division of the oblique muscles in living animals. There is no circumstance which proves more clearly the high degree of irritability of the eye, and the great extent

and variety of its motion, than the variety of sources from
which it derives its nervous influence; rendering it liable to
excitation from numerous causes, and inducing frequent mo-
tions of the globe, unconnected with volition.

The anatomy of the first pair of cerebral nerves leads us
at once to this consideration; for there is sufficient evidence
of the connection between the organs of vision and smell, by
the watering of the eye, and the peculiar motions of the globe
upon the introduction of any potent stimulus, or almost any
foreign body, into the nose: and this fact can only be ex-
plained, by the distribution of the filaments of the nasal branch
of the first division of the fifth pair on the mucous membrane
of the nose, demonstrating one source of the influence of the
" excito-motory" system on the eye. A physiological ques-
tion is naturally involved in this sympathy, as to the effects
it produces on the organ of vision, Whether it be for the pur-
pose of modifying sight, or merely connected with the passage
of the tears to the nose, as may be readily supposed from the
distribution of other filaments of the nasal branch of the fifth
pair to the lachrymal apparatus.

The second cerebral pair, or optic nerves, are the true seat
of the sense of vision, and are alone directly acted upon by
the admission of light. They are usually described as not
communicating with any other nerves; but the immediate in-
fluence on the transmission of light upon every structure of
the eye, and the consequent involuntary changes it undergoes,
sufficiently prove, at least, their indirect communication with
the other nerves of the organ of vision.

The third pair of nerves, or motores oculorum, as their
names imply, seem to be the principal agents in the motions
of the eye-ball. They supply the four straight muscles, the
levator palpebræ superioris, and the inferior oblique muscle.
This nerve arises from the inner margin of the crus cerebri,
just as it emerges from the pons Varolii, from those fibres
which can be traced from the anterior fibres of the corpus
pyramidale of the spinal marrow: hence, it is described as
being purely a nerve of voluntary motion. Some of its fila-
ments, however, may be traced into the cineritious matter of
the crus cerebri, commonly called the locus niger; from which
it is supposed, by Dr. Hall and Mr. Grainger, that this nerve

has an influence over the muscles to which it is distributed beyond the act of volition : these they term the incident or reflex filaments, through which may be explained various motions of the eye unconnected with cerebral consciousness.

The branch of the third pair, which supplies the inferior oblique muscle, receives a filament from the ophthalmic ganglion, and thus unites it with the sympathetic system, probably for the purpose of regulating the action of this muscle, as obedient to the secretion and flow of the tears.

Why the superior oblique and abductor muscles are not supplied by the third pair of nerves, is difficult to comprehend; but perhaps may be partly explained by the consideration of the fact, that a much greater degree of muscular force is necessary to direct the pupil outwards from its natural axis, than inwards, in which direction the field of vision is much less extensive; and therefore an additional source of nervous influence is required to evert the eyes. This hypothesis is somewhat proved by the pathological fact, that, in paralysis of the third pair of nerves, the pupil is permanently directed downwards and outwards, and, at the same time, dilated.

The fourth pair of nerves, or pathetici, come next in numerical order for consideration : they arise from the valve of Vieussens, and some few fibres from the testes. According to Sir Charles Bell, its filaments spring from the upper part of the spinal marrow, from the tractus respiratorius ; from which circumstance he considers that it produces a motion of the eye invariably concomitant with violent respiration. One can hardly consider, however, that any relation should exist between the functions of respiration and vision. It is true, indeed, that during forced respiration, as may be observed after very violent exertion, a peculiar expression and direction is given to the eye. Is not this, however, rather to be attributed to the cessation in the action of all the muscles during this period, when the function of every organ is more or less suspended, excepting those connected with respiration? The question, however, of what is the function of the fourth pair of nerves, and why it should alone supply the superior oblique, is still involved in mystery. I believe it will be found, upon investigation, that there is a much greater similarity between the origins of the third and fourth pair of nerves than is

usually pointed out by anatomists; for if the fibres of the
processus e cerebello ad testes be traced, from which the
fourth pair arise, they will be found, as described by Mr. Solly,
partly to interlace with the fibres of the sensory tract, and, in
part, to pass through the locus niger of the crus cerebri to
become continuous with the motory tract: so that, from this
double source, the fourth pair of nerves, like the third, be-
comes influenced both by the brain and the spinal marrow,
possessing both an incident and a reflex nerve of motion.
Why it should be distributed to the superior oblique muscle
only, may be, to afford the single influence of the muscle in
directing the pupil downwards and outwards, and to antago-
nize the action of the straight muscles, both in drawing the
globe forwards, and in rotating it.

The ophthalmic branch of the fifth pair of nerves is evi-
dently the nerve of common sensation to the organ of vision
and its appendages, affording the common source of the
incident to the motory filaments; and to produce, upon any
excitation, the motions of the eye, unconnected with volition.
It may be considered, indeed, as the great safeguard to the
whole organ; as is somewhat proved by the frequent occurrence
of injury to this nerve being followed by the destruction of
the eye; for no longer can the involuntary contraction of the
muscles, so essential to the function of vision, be performed.

The sixth pair of nerves arises, by one or two filaments, from
the corpus pyramidale of the medulla oblongata, inferiorly to
the groove between it and the pons Varolii: it passes for-
wards and upwards, by the side of the basilary artery, enters the
cavernous sinus, passes along the outer side of the internal
carotid artery, receiving two or three filaments from the
superior cervical ganglion of the sympathetic. Leaving the
cavernous sinus, it enters the orbit between the two origins of
the abductor oculi muscle, accompanied by the nasal branch
of the first division of the fifth and by the third pair: it then
separates from these nerves, and distributes its terminating
filaments to the abductor oculi muscle only.

The ophthalmic ganglion may be considered to the eye
what the rest of the sympathetic system is to every other part
of the body, maintaining that degree of irritability upon
which the action of its true involuntary muscles depends; main-

taining, also, the integrity of the function of secretion, and regulating the function of the capillary system, for the due appropriation of the blood; and also, perhaps, from its free communication with the nerves of motion and sensation, inducing a co-operation in their influence on the various muscles of the organ. The ophthalmic or lenticular ganglion is similar in its colour and consistence to the other ganglions of the sympathetic nerve, and is connected by filaments to the superior cervical ganglion: it is placed upon the outer side of the optic nerve, at the back part of the orbit, between it and the abductor oculi muscle. This ganglion sends a filament to be united to the nasal branch of the first division of the fifth pair; a second downwards, to be connected with that branch of the third pair which is distributed to the inferior oblique muscle; and it is also connected with the sixth pair of cerebral nerves, through the medium of the filaments of communication between the ophthalmic and superior cervical ganglion of the sympathetic system. From the anterior part of the ophthalmic ganglion, two bundles of filaments are distributed forwards along the outer side of the optic nerve; which soon form themselves into superior and inferior fasciculi, under the name of the ciliary nerves, penetrate the sclerotic coat, anastomosing with the ciliary filaments of the nasal branch of the first division of the fifth pair, and are destined to supply the iris.

The fourth pair of nerves within the cavernous sinus also receives filaments from the sympathetic plexus within that cavity; so that, in fact, all the nerves which enter the orbit act upon the various muscles to which they are distributed through the influence of the sympathetic system; and hence it is, that, independent of volition, the eyes are moved and regulated for the transmission of light, for the passage of the tears, and for their preservation against external injury.

That there is a variation in the form of the eye during the examinations of objects at different distances, and under different degrees of light, is demonstrable, from the examination of the organ while employed in perusing the smallest print, in gazing over an extensive distance, and on the admission of an intense or slight degree of light; but upon what this change depends, is not so satisfactorily explained. By

some, it is supposed that the adaptation of the eye, under these
circumstances, is effected entirely by the action of the muscles;
and that the drawing back of the globe by the contraction of
the straight muscles, and the simultaneous compression on the
periphery of the sphere, increases the long axis of the eye, and
renders it more convex anteriorly; while, at the same time, it
perhaps renders plane the fold in the retina, at the foramen
of Soemmering, probably inducing some considerable and im-
portant change in the eye.   It has also been believed that the
simultaneous contraction of the straight muscles must tend to
compress the ophthalmic veins, and prevent, in some measure,
the ready return of blood from the eye; and thus induce an
increased tension in the organ, sufficiently to alter the refrac-
tive power of its humours, and, from a tendency to a state of
congestion in the iris, to lead to a contraction of the pupil.   This
latter view would be principally dwelt upon by those who
doubt the muscularity of the iris.   The oblique muscles seem
to perform the rotatory motions of the eye, and to act as mo-
derators to the straight muscles: and it appears doubtful if
either of them act singly, but are always assisted by the
directing force of one or more of the straight muscles, which
cannot be considered as wholly voluntary, but partly under
the influence of the sympathetic nerve; which may in some
measure account for the fact, that, in directing the two eyes
to any lateral object, it is not the corresponding muscle which
directs the eyes towards that object, but, indeed, two opposing
muscles; for the adductor on one side, and the abductor on the
other, are employed for the direction of the two eyes to the
same point, which neither the decussation of the optic, nor the
effect of the stimulus of light upon corresponding nerves, pro-
duces; for the two influences derive their nervous energy
from different sources.

I shall now proceed to detail the result of experiments
which I have made upon rabbits, in dividing the oblique
muscles of the eye, for the purpose of ascertaining the effect
produced upon the motions of that organ.   In the first place,
I carefully dissected the muscles of the eye, and the nerves
which are distributed to them in the rabbits, to ascertain if there
were any anatomical reasons why an analogy should not be

drawn, in the use of their muscles, with those of the human subject; and could discover none, beyond the existence of the retractor muscle of the globe, common to most quadrupeds. The straight muscles bear, in every respect, a close resemblance to those of the human subject. The superior oblique muscle, also, is very similar in its attachments and direction: arising from the posterior part of the orbit, passing forwards towards the inner angle of the eye, and there becoming tendinous, it runs through a fibro-cartilaginous ring, and is then reflected backwards, at a very acute angle; and again becoming muscular, is inserted into the scleretic coat, beneath the superior straight muscle, and posteriorly to the great circumference of the globe.

The inferior oblique muscle in the rabbit does not bear so strong a resemblance to the corresponding muscle in the human subject as the other muscles of the organ of vision. It arises, broad and fleshy, from the most anterior internal and inferior part of the orbital cavity, takes its direction downwards along the floor of the orbit, and then passes upwards, outwards, and backwards; expanding, as it terminates, to be inserted in the outer part of the globe, posteriorly to the insertion of the recti muscles: it seems, however, that some few of its fibres pass towards the anterior part of the sclerotic coat. In proportion to the size of the globe of the eye, this muscle is larger than in the human subject, is more deeply seated within the orbit, and has a broader attachment to its inner wall.

Upon taking hold of the muscles with the blades of the forceps, and drawing their points of insertion towards their origin, viz. in the direction of their natural contraction, the following results, in my experiments, have invariably occurred:—

On acting on the superior oblique, the point of insertion of this muscle was drawn upwards, forwards, and inwards: the globe of the eye, at the same time, turning on its own axis, and somewhat projected forwards from the orbiter cavity, had the pupil directed downwards and outwards, corresponding with the description usually given of the natural action of this muscle.

Acting in a similar manner on the inferior oblique muscle, its point of insertion was made to roll from without inwards,

and slightly from behind forwards, directing the pupil upwards
and outwards. If, however, the force were still increased, but
yet not apparently beyond the natural contraction of the
muscle to one-third of its length, the pupil was made to roll
under the eye-brow, so as to be turned inwards;—a direction,
however, which is greatly increased, if the eye-lids be brought
in contact, as might be felt by the globe rolling under the
fingers.

As I have already mentioned, however, in an early part
of this Paper, there is a considerable variety of opinion
as to the direction given to the pupil by the action of this
muscle; as Sir Charles Bell, Mr. Dalrymple, and some others,
seem to maintain that the moderate contraction of this muscle
rolls the pupil upwards and inwards. One use of these muscles
seems to be, to maintain the globe of the eye at an equal di-
stance from the roof and floor of the orbit, as will be described
when speaking of the effects of the division of these muscles.

To facilitate the experiments of dividing the oblique muscles
of the eye, I had a rabbit's head, with the muscles dissected,
placed before me in the same position as the head of the
living rabbit upon which I was about to perform the experi-
ment. I then removed a small portion of skin from the upper
eye-lid, immediately over the superior ridge of the orbit,
divided the tunica conjunctiva, and passed either a hook or a
pair of forceps into the orbit, and seized the tendon of the
superior oblique muscle, posteriorly to the trochlea.

For the division of the inferior oblique, in my first experi-
ments, in a similar manner I removed a portion of the inferior
eye-lid, and, cutting through the tunica conjunctiva with a pair
of probe-pointed scissors or bistoury, divided the inferior ob-
lique. This plan, however, I found not to be so good as
passing a phymosis-knife, through the eye-lid and conjunctiva,
into the orbit, and then dividing the muscle. By either mode,
however, the division of the inferior oblique is much more
difficult than the superior, and apparently causes infinitely
greater pain to the animal.

The following were the results, as presented in five experi-
ments which I performed; in each of which the superior ob-
lique muscle was divided in the one eye, and the inferior
oblique in the other. Invariably, a considerable difference is

observed with respect to the degree of prominence of the two eyes: that one in which the superior oblique muscle had been divided never presented the same degree of prominence as the eye in which the inferior oblique had been cut through, seeming as if it were really preternaturally drawn into the orbit; while the eye in which the inferior oblique had been cut through looked as if projected; which, however, I think, is only attributable to the contrast between the two. The whole globe of the eye, on the side on which the superior oblique is divided, becomes depressed, as if resting on the floor of the orbit, the aspect of its cornea and iris rather dull, the pupil somewhat smaller and slightly turned inwards, and the power of vision, as far as I was capable of judging, impaired.

It is to be observed, that the retraction and depression of the globe form the principal results of the division of the superior oblique muscle. Some may be disposed to dwell on the slight direction inwards of the pupil; and contend, that the preponderating influence of the inferior oblique now produces that inversion: but it seems to me, that the combined action of the adductor and inferior oculi muscles, having lost the moderating influence of the superior oblique, would necessarily give this permanent direction to the eye; for the inferior oblique, at any rate, would have a tendency to direct the pupil upwards, whatever may be the dispute as to the direction outwards or inwards.

On the division of the inferior oblique muscle shortly after the experiment, and as soon as the animal had become quiet so as to enable us to examine the position of the eye, the globe appeared much projected from the orbit, and raised towards its roof, the pupil being directed outwards and slightly backwards. This condition of the organ followed as the result of every experiment I performed; nor did any change of position in the eyes take place, although some of the animals were kept a week or ten days after the experiment.

The power of vision seemed always most considerable in the eye in which the inferior oblique muscle had been divided, as was proved by the efforts the animal made to avoid any foreign body projected towards it: and, indeed, the manner in which it seemed capable of rolling the eye upwards and inwards, to avoid injury, leads me much to doubt the opinions

of those who consider the oblique muscles as the involuntary safeguards to the eye.

The general deductions which may be drawn from the result of these experiments, are, that the oblique muscles, when acting together, suspend the eye-ball in a central position in the orbiter cavity, moderate the retracting influence of the four straight muscles, and, when acting in succession, without being restricted by the influence of the recti, they roll the eye on its own axis, drawing the globe forward, and at the same time tending, in a great degree, to extend the sphere of vision. This latter use appears to me a fair inference, from the great loss of mobility the eye sustains after the division of either of the oblique muscles. In one or two of the rabbits I divided both the oblique muscles in the same eye; the result of which experiment was, the permanent retraction of the globe within the orbit, its depression on the floor of that cavity, the contraction of the pupil, without, however, any lateral direction. I am aware that the precise direction given to the pupil by the contraction of either of these muscles has not been proved by the foregoing experiments; as, upon the division of one of them, the eye is not left controlled by the action of the other alone, but must necessarily partake of the influence of the recti muscles. Much, therefore, I feel convinced, is yet left to be done by the pathologist, rather than by the experimentalist.

LIST

OF

GENTLEMEN EDUCATED AT GUY'S HOSPITAL,

WHO HAVE BEEN ADMITTED

MEMBERS OF THE COLLEGE OF SURGEONS,

AND THE APOTHECARIES' HALL,

SINCE SEPTEMBER 1837.

College of Surgeons:

OCT. 1837.

Mr. John Birkett.
— Dennis Rock.
— Edward Hetherington.
— Henry Shaw.

Mr. H. Bidwell.
— Nicholas Rundle.
— Charles Chapman.

NOVEMBER.

Mr. W. Cuthbert.
— Henry Hales.

Mr. George Hill Smith.

DECEMBER.

Mr. C. P. Mann.

JANUARY 1838.

Mr. George H. Betts.
— H. Bickersteth.

Mr. Edward Chinery.

FEBRUARY.

Mr. John Edge.
— James Scott.

Mr. E. Y. Knowles.

APRIL.

Mr. George Bakewell.
— Frederick George Rose.
— Thomas K. Strover.
— William Williams.
— Charles Taylor.
— Daniel G. Thackeray.

Mr. James L. Lowry.
— Robert Bacon.
— Alfred Aspland.
— Thomas M. Price.
— Robert Molloy.
— Thomas Mather.

MAY.

Mr. G. H. Whimper.
— T. B. Barrett.
— W. R. Cooke.
— J. W. Swinburn.
— Richard Valpy Shuter.

Mr. Charles Sawer.
— J. Anningson.
— J. M. Burton.
— G. Bond.

JUNE.

Mr. S. R. Robinson.
— Charles Webb.
— Charles Taylor.

Mr. Edward Knowles.
— E. M. Prynn.

JULY.

Mr. C. W. C. Otway. | Mr. John Coales.
— T. B. Easton. |

AUGUST.

Mr. George Dry. | Mr. T. W. Foster.
— Launcelot Hare. | — Edward Howard.
— W. F. Babington. | — J. M. Gittins.
— R. I. H. Scott. |

Apothecaries' Hall:
OCT. 1837.

Mr. W. F. Shoebridge. | Mr. Charles Chapman.
— Alfred Drew. | — J. B. Mather.
— George Cooper. |

NOVEMBER.

Mr. Thomas Bourne. | Mr. Edward Briant.
— E. H. S. Banks. | — John Breach.
— Edward Knowles. |

DECEMBER.

Mr. Martin Mauger.

JANUARY 1838.

Mr. James J. Clarkson. | Mr. Edward Newbould.
— George Newstead. | — Charles Taylor.

FEBRUARY.

Mr. John M. Burton. | Mr. Edward Young.
— J. H. Nankivell. | — R. I. H. Scott.
— W. Benjamin Hemming. |

APRIL.

Mr. Robert Welham.

MAY.

Mr. Frederick George Rose. | Mr. Charles Hallett.
— Thomas S. Lacy. | — William Williams.
— Edward Ray. | — James Harrhy.
— T. B. Barrett. | — Charles Nind.
— R. H. Cooke. |

JUNE.

Mr. John Jolliffe. | Mr. George Brunton.

AUGUST.

Mr. John Chapman. | Mr. John Coales.
— William Roderick. | — Samuel K. Russell.

MEDICAL SCHOOL OF GUY'S HOSPITAL.

At the close of the Session 1837-8 the following Prizes, Certificates of Distinction, and Honorary Diplomas of the Physical Society, were awarded in the Council Room of the Hospital.—
Sir Henry Halford, Bart. in the Chair.

PHYSICAL SOCIETY.
Professor Müller, of Berlin .... Honorary Diploma.
Mr. Aspland .... ⎫
Mr. Chevers .... ⎬ Diploma.
Mr. Brereton .... ⎪
Mr. Gorham .... ⎭

PRACTICE OF MEDICINE.
Mr. John Brett .... Gold Medal.
Mr. Lancelot Hare .... Silver Medal.
Mr. Allen Williams .... Book.

CHEMISTRY.
Mr. John Beevor .... Prize.
Mr. John B. Wilson .... Certificate of Distinction.
Mr. Henry G. Noyes .... Certificate of Distinction.

ANATOMY.
Second Year.. Mr. John C. Parrot ...... Silver Medal.
Mr. Edward Menzies..... Silver Medal.
First Year.... Mr. Thomas O. Duke .... Gold Medal.
Mr. R. Williams .... Silver Medal.
Mr. Walter Chapman ..... Certificate.
Mr. Thomas Guy .... Certificate.

SURGERY.
Mr. John Coales .... ⎫ Æquales—Prize.
Mr. John Fred. France ..... ⎭

OPHTHALMIC SURGERY.
Senior .. Mr. John Fred. France........ Silver Medal.
Mr. Joseph Dunn Nelson ...... Bronze Medal and Certificate.
Mr. John Chapman .... Certificate of Distinction.
Mr. J. G. D. Denham .... Certificate of Distinction.
Junior.. Mr. Charles Otway........... Silver Medal.

MIDWIFERY.
Second Year .. Mr. Joseph R. Bedford.... Prize.
Mr. Edward Ray .... Prize.
First Year.... Mr. Edward R. Houlden .. Prize.
Mr. William Thomsett .... Certificate of Distinction.

BOTANY.
Mr. Frederic Leopold Pulling . Prize.
Mr. Thomas O. Duke .... Certificate.

EXPERIMENTAL PHILOSOPHY.
Mr. Thomas Longmore .... Prize.
Mr. Lancelot Hare .... Certificate.

CLINICAL SOCIETY.
Mr. Allen Williams .... Certificate.